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Obstructive Sleep Apnea Educational Intervention of Dental Hygiene Students

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Eastern Washington University

Obstructive Sleep Apnea Educational Intervention of Dental Hygiene Students

A Thesis

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in

Dental Hygiene

in the

College of Graduate Studies

Eastern Washington University

by

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Spring 2017

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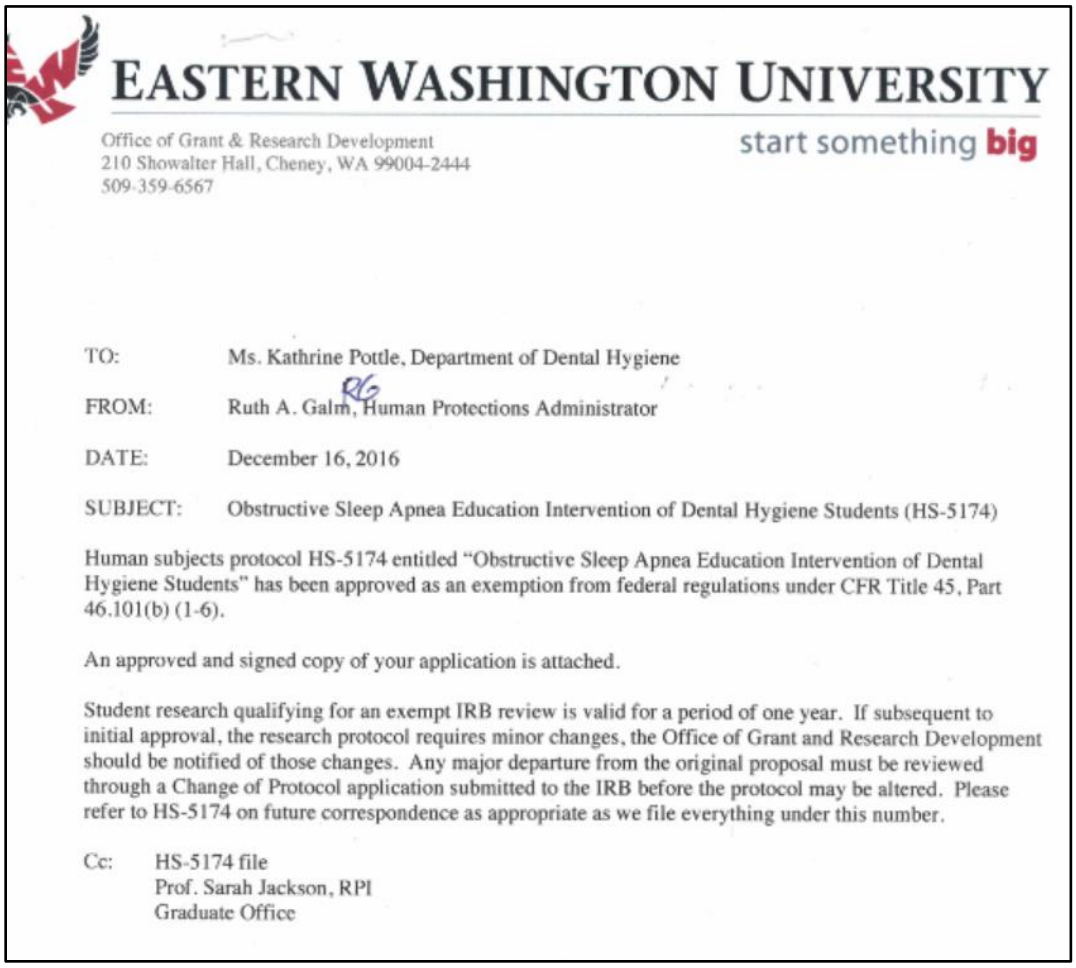

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SUBJECT: Obstructive Sleep Apnea Education Intervention of Dental Hygiene Students (HS-5174)

Human subjects protocol HS-5174 entitled "Obstructive Sleep Apnea Education Intervention of Dental Hygiene Students" has been approved as an exemption from federal regulations under CFR Title 45, Part 46.101(b) (1-6).

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Title of Project: Obstructive Sleep Apnea Educational Intervention of Dental Hygiene Students

For students only: Is this research being done to meet a course, thesis, or other academic requirement? (please specify)

This research is being done to meet a thesis requirement for the Master of Science in Dental Hygiene degree.

Project anticipated starting date: January 9th, 2017 (pilot study)
Anticipated termination date: December 31st, 2017

Funding: non-funded
Funding status: N/A
Funding Agency: N/A Grant or Contract Number: N/A

Check the type of exemption applicable to the project

1. X 2. ____ 3. ____ 4. ____ 5. ____ 6. ____ None ____

Why should this project be considered exempt?

This project should be considered exempt as it will be conducted within an established educational setting, the Eastern Washington Dental Hygiene Program. Additionally, the research is on the effectiveness of an instructional technique – an online educational module for dental hygiene students.

Please state the purpose and methodology of the research:

The purpose of this research is to determine if an online educational intervention can significantly increase the knowledge of information relevant to obstructive sleep apnea screening in dental hygiene students.

The proposed research will have a mixed method, one-group, pre-test/post-test design. The research protocol will be conducted online using Canvas©, SurveyMonkey©, and YouTube. A pilot test of the educational intervention will be conducted with graduate students that entered the Eastern Washington University (EWU) Master of Science in Dental Hygiene (MSDH) program in the fall of 2015. The convenience sample will consist of students enrolled in DNHY 341S *Management of Medically Compromised Patients* at EWU. The topic of obstructive sleep apnea (OSA) is included in the course content of this course in the spring academic semester.

The course instructor of DNHY 341S will introduce the research study to potential participants using the *Research Introduction Script* and will assign each student with a random identification number. The primary investigator (PI) will not have access to the data that corresponds students' names to identification numbers. Students will be asked to provide their identification number for each SurveyMonkey© assessment, which will include a pre-test, demographic questionnaire, post-test, program evaluation, and an identical second post-test. The course instructor for DNHY 341S will create a module within Canvas© that will include SurveyMonkey© links and an OSA educational video. The proposed OSA educational module will be required as DH course content for sleep medicine, but consent to the use of anonymous assessment data will be voluntary. Students will be asked in the pre-test if they consent for their anonymous confidential assessment data to be used for research and publication purposes. As an incentive for participation, pizza will be provided during DNHY 341S if all eligible students consent to the research study and complete the entire research protocol.

Describe the procedures: what specifically will subjects do? If data are anonymous, describe the data gathering procedure for insuring anonymity.

Pilot study participants will be emailed a cover letter and consent form explaining the research. The email will contain SurveyMonkey and YouTube links and instructions for the pilot study. Participants will be given one week to complete the pre-test and demographic questionnaire, view the OSA education video, complete the post-test and program evaluation, and

provide feedback via an anonymous SurveyMonkey link.

During the DNHY 341S course on Thursday, January 26th, the course instructor will introduce the research study using the *Research Introduction Script*, and will provide students with a random identification numbers. The Canvas module will open for students directly following class on this day. The opened module will contain active SurveyMonkey© links for the pre-test and demographic questionnaire and will remain active until Sunday, January 29th. Upon opening the SurveyMonkey link for the pre-test, students will be asked if their anonymous data from the pre-test, post-test, demographic questionnaire, program evaluation, and second post-test may be used for research and publication purposes. On Monday, January 30th, the YouTube link for the OSA educational video will become active and will remain active until Sunday, February 5th. The link for the post-test and program evaluation will become active on Monday, February 6th and will remain active until Thursday, February 9th. SurveyMonkey© data from the post-test will be forwarded to the course instructor, who will assign student grades. During the DNHY 341S course on Thursday, February 23rd, the course instructor will remind students to complete the post-test a second time. The link for the second post-test will be activated directly following this class, and will remain active until Thursday, February 26th. Only the first post-test will influence student grades. If all eligible participants consent to the research study and complete the entire research protocol, pizza will be provided during the DNHY 341S course on March 2nd.

To assure anonymity, SurveyMonkey© settings will be set to *anonymous responses*, which eliminates personally identifiable data from survey results. All data exported from SurveyMonkey© will be kept in a password-protected computer only accessible by the researcher. The primary investigator (PI) will not have access to the data that corresponds students' names to identification numbers. The course instructor will be forwarded SurveyMonkey© results of the first post-test, but will not have direct access to SurveyMonkey© data, including data regarding who consented to the research study.

Attach all surveys, questionnaires, cover letters, information sheets, etc. (including required IRB contact information (see instructions)

Attached: Pilot Study Cover Letter/Consent Form (Appendix A), Research Introduction Script (Appendix B), Canvas© Module Content (Appendix C), Topical Outline of OSA Educational Video (Appendix D), Pre-test/Post-test (Appendix E), Demographic Questionnaire (Appendix F), Program Evaluation (Appendix G), Informed Consent Statement (Appendix H), and Pilot Study Instruction (Appendix I).

SurveyMonkey links:

Pre-test: https://www.surveymonkey.com/r/QQ2PPQM

Demographic Questionnaire: https://www.surveymonkey.com/r/QQQVSXL

Post-test #1: https://www.surveymonkey.com/r/QQRSQQC

Program Evaluation: https://www.surveymonkey.com/r/QQMQL78

Post-test #2: https://www.surveymonkey.com/r/QJPYTJT

Pilot study feedback: https://www.surveymonkey.com/r/MQ8BDSS

The information provided above is accurate and the project will be conducted in accordance with applicable Federal, State and University regulations and ethical standards.

Signature, Principal Investigator(s) Katie Pattee Date 12/14/16

Recommendations and Action		Date	Approve/Disapprove
Faculty Sponsor (for student)	Pam Tate	12/14/16	Approve
Dept IRB Representative or Dept Chair	Annokel Lytsman	12/14/16	Approve
Institutional Review Board	Ruth A. Graham	12/16/16	Approve

Conditions: none Approved from 12/16/16 To 12/15/17

Abstract

Purpose: Dental hygienists (DHs) have a unique opportunity to screen for OSA, but receive limited OSA education within the DH curriculum. This study was conducted to determine if an online educational intervention could significantly increase the knowledge of information relevant to obstructive sleep apnea (OSA) screening in dental hygiene (DH) students.

Methods: OSA knowledge was assessed with a 17 question, comprehension based pre-test and post-test. The convenience sample consisted of first year DH students enrolled in DNHY 341S *Management of the Medically Compromised* at Eastern Washington University (EWU). Participants completed the pre-test, viewed the OSA educational video, completed a post-test, and completed a second post-test two weeks following completion of the educational module. Pre-test and post-test answers were compared to determine the change in knowledge. Pre-test and first post-test answers were compared to second post-test answers to evaluate knowledge retention.

Results: Thirty-three participants completed the pre-test and post-test, and 28 (85%) completed the second post-test. Participants had a significant improvement in first and second post-test scores compared to pre-test scores ($p < .001$, $t(33) = 9.836$). Following completion of the online educational module, all participants (n=33) indicated they believed screening for OSA was important, and 76% of participants (n=25) indicated they were *likely* or *very likely* to evaluate adult patients for OSA.

Conclusion: An online OSA educational module is an effective educational strategy to increase the OSA knowledge of DH students.

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Introduction/Literature Review

Introduction to the Research Question

Obstructive Sleep Apnea (OSA) is a sleep disorder gaining the attention of oral health professionals. This disorder is characterized by multiple occurrences of complete or partial upper airway obstruction during sleep (American Academy of Sleep Medicine, Adult Obstructive Sleep Apnea Task Force, 2009). The health condition is often identified by sleeping partners who observe an alteration in their partner's breathing and snoring, as well as reports of excessive daytime tiredness (AASM Adult OSA Task Force, 2009). Several associations exist between OSA and other health conditions, including: hypertension, stroke, diabetes mellitus, and various cardiac conditions (Lee, Nagubadi, Kryger, & Mokhlesi, 2008). Additionally, a recent systematic review and meta-analysis determined evidence of a plausible association between OSA and periodontal disease (Al-Jewair, Al-Jasser, & Almas, 2015).

Dental hygienists (DHs) have a unique opportunity to screen for OSA, as they typically spend substantial time with patients, and in a close proximity (Kornegay & Brame, 2015). Simple screening methods are available to identify patients at high risk for OSA. In a recent thesis research study, it was estimated only 5% of dental hygiene programs include OSA screening methods in their curriculum (Minichbauer, 2014). These research findings suggest that supplemental education may be necessary to prepare

DHs to screen for OSA. In a 2014 study, a sample of nurse practitioners experienced significant improvement in post-test scores as compared to pre-test scores following the completion of an online OSA educational program. The results of these studies begin to illustrate the need for an online OSA educational intervention for DHs.

Theoretical/conceptual framework. Current research suggests the time dedicated to the education of OSA in DH curriculum is insufficient to produce DHs who are prepared to screen for OSA (Minichbauer, 2014). With only 32% of DH programs reporting OSA education in their curriculum, an investigation into the effectiveness of alternative educational methods is warranted (Minichbauer, 2014). Research has been conducted on the potential of online OSA education for healthcare professionals. One particular study, that utilized an online, narrated OSA PowerPoint presentation, called for further research of comparable educational methods for various healthcare professions (Valerio & Heaton, 2014).

For the current study, a multidimensional educational intervention was created. Within the educational module, general OSA content was provided, including prevalence and risk factors, as well as methods of OSA diagnosis and treatment. Lastly, because the primary intent of the educational intervention is to produce DHs who are knowledgeable about and skilled in screening methods of OSA, key OSA screening methods was demonstrated.

Statement of the Problem

The American Dental Hygienists' Association (ADHA) discusses diagnostic testing and assessments as part of basic science research in the *ADHA Dental Hygiene Conceptual Research Model* (ADHA Council on Research, 2016). Diagnostic testing and

assessment is described as the "discovery of new tools for diagnosis of conditions and diseases and new methods of risk assessment prior to development of disease" (ADHA Council on Research, 2016, p. 9). Considering OSA is an associated risk factor of both oral and systemic diseases, investigation of OSA risk assessment opportunities for the DH is warranted. Additionally, the Healthy People 2020 sleep health objective to "increase the proportion of persons with symptoms of obstructive sleep apnea who seek medical evaluation" illuminates the need for health professionals well-educated in OSA (Health People 2020, 2016). Presently, a supplemental OSA education program for DHs is not readily available.

Research question. Given the role of the DH in screening for OSA, the ADHA research agenda, and the systemic risk of OSA, this proposed study sought to answer the following question: Can an online educational intervention significantly increase the knowledge of information relevant to OSA screening in DH students?

Overview of Research

A comprehensive overview of existing OSA research is needed to illustrate the need for an OSA educational module for DHs. To value the need for increased OSA screening, a thorough understanding of the disorder is required. Research relevant to this research study includes background information on OSA, relevance to oral health professionals, and core components of an OSA educational module.

Background information. Due to the high prevalence and significant associated risks accompanying undiagnosed OSA (Lee et al., 2008), pertinent research has emerged. To comprehend this complex sleep disorder, it is necessary to establish the epidemiology

of OSA, the health conditions associated with OSA, and the consequences associated with the untreated condition.

Epidemiology. Currently, there is no established mechanism in the United States to monitor the prevalence of sleep-disordered breathing (SDB) over time (Peppard et al., 2013). Due to methodological differences among epidemiology studies, it is challenging to determine prevalence with a high degree of confidence. In 2013, Peppard et al. conducted a study to estimate the prevalence of SDB by combining information from the Wisconsin Sleep Study, an ongoing community-based study, with US National Health and Nutrition Examination Survey (NHANES) data. Within this study, "the prevalence of SDB was modeled as a function of age, sex, and body mass index, and estimates were extrapolated to US body mass index distributions estimated using data from the NHANES" (Peppard et al., 2013, p. 1006). The estimated prevalence of SDB during the periods of 1988-1994 and 2007-2010 was determined by studying the results of Wisconsin Sleep Study participants aged 30-70 years old (N=1,520). These individuals were randomly selected from the adult, employed Wisconsin population as part of the Wisconsin Sleep Study, and each received a polysomnography (PSG) sleep study to assess the presence of SDB (Peppard et al., 2013). From this data, it was estimated the overall prevalence of mild to severe SDB (apnea-hypopnea index (AHI) $\geq$ 5) was 26% (95% CI: 24, 28) among individuals 30-70 years of age in the time period of 2007-2010 (Peppard et al., 2013). The estimated overall prevalence of moderate to severe SDB (AHI $\geq$ 15) for the same time period and age range was 10% (95% CI: 8, 11) (Peppard et al., 2013). More specifically, 13% of men and 6% of women aged 30-70 years were estimated to have moderate to severe

SBD from 2007-2010, an increase from the 8.8% of men and 3.9% of women estimated between 1988-1984 (Peppard et al., 2013).

The results from this study are inconsistent with more dated OSA epidemiology studies. In 2008, the National Institutes of Health (NIH) funded a Public Access Author Manuscript that reviewed eight population-based OSA studies (*N*=8) and estimated the prevalence of mild to severe OSA (AHI $\geq$ 5) to be approximately 9% in women and 24% in men aged 30-60 years old (Lee et al., 2008). In comparison, Peppard et al. (2013) found the prevalence of mild to severe SDB (AHI $\geq$ 5) in individuals aged 30-70 years old to be approximately 13.2% in women and 26.4% in men from 1988-1984, and 17.4% in women and 33.9% in men from 2007-2010. The difference in age and time ranges between these studies demonstrate how methodological differences make determining OSA with a high degree of confidence difficult.

Evidence also suggests a large percentage of individuals with OSA are undiagnosed (Lee et al., 2008). In the review article by Lee et al. (2008), it was found 80% of individuals who demonstrated moderate to severe OSA in the Wisconsin Sleep Cohort and the Sleep Heart Health Study remained undiagnosed over a decade later. Additionally, in the 2011 Sleep in America Poll, individuals were interviewed regarding their sleep habits (*N*=1,508). Participants were asked questions regarding how likely they were to fall asleep during different activities using the Epworth Sleepiness Scale (ESS). Of the participants who fully completed the ESS, (*n* value undisclosed), 13% of respondents were classified as high risk for OSA (National Sleep Foundation, 2011 Poll Task Force, 2011). As research continues to unveil a high prevalence and low diagnosis

rate for OSA, recognition and comprehension of the consequences of untreated OSA is imperative.

Associated health conditions. There are several prominent health conditions associated with OSA. In the literature review conducted by Lee et al. (2008), prominent associated health conditions identified included: hypertension, stroke, coronary artery disease (CAD), congestive heart failure (CHF), and type II diabetes mellitus (T2DM). It is important to note that as several of the health conditions associated with OSA are also associated with obesity, causation cannot be determined. Regardless, each of these health conditions pose a significant risk to individuals at high risk for OSA and are summarized in Figure 1.1.

Systemic hypertension. According to Torres, Sanchez-de-la-Torre, and Barbe (2015), epidemiologic data suggests an association between OSA and systemic hypertension. Specifically, the relationship between OSA and hypertension appears to be bidirectional. Individuals with hypertension are more likely to have OSA, as well as individuals with OSA have a higher prevalence of hypertension (Torres, Sanchez-de-la-Torre, & Barbe, 2015). In a 2012 study, the association between treated and untreated OSA and the risk of hypertension was investigated (Marin et al., 2012). This prospective cohort study was conducted in Zaragoza, Spain and included participants without hypertension, or previous treatment of OSA, who were referred by a physician to a sleep center for polysomnography (PSG) evaluation between January 1, 1994 and December 31, 2000. A total of 1889 individuals qualified for participation in the study, 1579 participants with OSA (n=1579) and 310 controls without OSA (n=310) (Torres et al., 2015). Follow-up visits with these individuals up to January 1, 2011 was documented, in

which participants were evaluated for hypertension. Hypertension was defined as a systolic blood pressure at rest of 140 mm Hg or higher, and a diastolic blood pressure at rest of 90 mm Hg or higher measured by a nurse blinded to the presence of absence of OSA. Additionally, participants' adherence to treatment with CPAP for an average of 4 or more hours per day was documented (Torres et al., 2015). The crude rate of hypertension per 100 person-years was identified for controls, participants with OSA ineligible for CPAP treatment, participants with OSA who declined CPAP treatment, patients non-adherent to CPAP treatment, and participants with OSA that were adherent to CPAP treatment, and was 2.19 (95% CI, 1.71-2.67), 3.34 (95% CI, 2.85-3.82), 5.84 (95% CI, 4.82-6.86), 5.12 (95% CI, 3.76-6.47), 3.06 (95% CI, 2.70-3.41), respectively (Torres et al., 2015). From these results, the authors of this study suggest untreated OSA is associated with a higher risk for developing new-onset hypertension ($p < 0.001$), even after adjusting for potential confounding variables, including baseline BMI and change of BMI over time. Additionally, participants who were treated for OSA with CPAP had a risk for developing new-onset hypertension similar to that of controls, after adjusting for cofounders (Torres et al., 2015). This study demonstrates the potential health benefit, regarding a reduced risk for hypertension, that increased OSA screening, diagnosis, and treatment can have for patients. Despite the established association, Torres et al. (2015) states the association between OSA and incident risk of hypertension is still not understood.

Stroke. Another significant consideration for individuals at high risk for OSA is the associated risk of stroke. In a 2015 retrospective, case-control study, the association between cardioembolic (CE) stroke and OSA was investigated by conducting a chart

review of 1605 consecutive records at the Mayo Clinic (Lipford et al., 2015). Cardioembolic stroke occurs when the heart pumps unwanted material into blood vessels of the brain, causing a blockage and subsequent damage to the brain (Leary & Caplan, 2008). To be included in the study, participants (N=53) must have underwent a standard PSG at the Mayo Clinic and had an ischemic stroke within one year after the PSG was conducted. Of the 53 individuals who qualified for the study in regards to time frame and ischemic stroke, 60% (n=32) had OSA (AHI > 10) and were classified as participants, and 40% (n=21) did not have OSA (AHI $\leq$ 10) and were classified as controls (Lipford et al., 2015). The only comorbidity significantly different between those with and without OSA was atrial fibrillation (AF), which was significantly more common in those with OSA than the control group (19 versus 5, p = 0.01). The study found strokes in patients with OSA were predominantly CE strokes, and that CE strokes were significantly more common in patients with OSA than in controls (23/32 versus 7/21, p = 0.01). Additionally, the majority of these strokes occurred in individuals with moderate to severe OSA (Lipford et al., 2015). The authors of the study hypothesized the high prevalence of CE strokes in patients with OSA may be attributed to the relationship between OSA and AF, or OSA may predispose individuals to cardiovascular changes applicable to CE. The results of this study demonstrate the significance of untreated OSA on the risk of stroke in individuals.

Coronary artery disease. In addition to hypertension and stroke, individuals with coronary artery disease (CAD) have a higher prevalence of OSA (Wali et al., 2015). In a 2015 article, the prevalence of OSA in patients with CAD was investigated among patients of the King Abdulaziz University Hospital in Saudi Arabia (Wali et al., 2015).

This cross-sectional study recruited patients who demonstrated CAD based on coronary angiography between April 2012 and December 2013. A total of 156 patients with diagnosed CAD agreed to participate in the study (*N*=156) (Wali et al., 2015). During the first phase of the study, trained physicians interviewed participants and collected demographic data, information on comorbidities, STOP-BANG questionnaire results, and coronary angiographic findings. In the second phase, 50% of individuals at high risk for OSA based on the STOP-BANG questionnaire were randomly selected to receive PSG to determine OSA diagnosis, although only 37.5% (*n*=48) agreed to undergo the evaluation (Wali et al., 2015). Of those high risk individuals with CAD, 68.8% (*n*=33) suffered from OSA. Assuming individuals determined to be low risk for OSA based on the STOP-BANG questionnaire truly did not have OSA, it was estimated OSA in the total population of CAD patients was 56.4% (*n*=88) (Wali et al., 2015). Although several limitations of this study exist, including the fact only individuals actively seeking CAD diagnosis were eligible to participate, this study suggests a significantly high prevalence of OSA in individuals diagnosed with CAD.

Congestive heart failure. In continued consideration of cardiovascular diseases, OSA has been associated with a higher prevalence of congestive heart failure (CHF) (Kasai & Bradley, 2011). According to an article by Kasai and Bradley (2011), "OSA exposes the cardiovascular system to intermittent hypoxia, oxidative stress, systemic inflammation, exaggerated negative intrathoracic pressure, sympathetic over activation, and elevated blood pressure (BP). These can impair myocardial contractility and cause development and progression of heart failure" (p. 119). The authors of the study referenced results from the Sleep Heart Health Study, that suggested OSA with an AHI $\geq$

11 was independently associated with 2.38 relative odds of an individual having CHF (as cited in Kasai & Bradley, 2011). As individuals with OSA have a higher than normal relative odds for CHF, the need to identify individuals at high risk for OSA becomes relevant to individuals suffering from, or at high risk for CHF.

Type II diabetes mellitus. Lastly, type II diabetes mellitus (T2DM) is considered to be an adverse health condition associated with OSA. According to Nannapaneni, Ramar, and Surani (2013), OSA is independently associated with glucose intolerance and insulin resistance. The authors of the literature review suggested up to 40% of patients with OSA have diabetes, and up to 23% of individuals known to have diabetes may also have OSA (Nannapaneni, Ramar, & Surani, 2013). Additionally, a study published in 2014 investigated the association between OSA and incident diabetes (Kendzerska, Gershon, Hawker, Tomlinson, & Leung, 2014). For this cohort study, adults without previous diabetes diagnosis who underwent PSG evaluation at St. Michael's Hospital in Toronto, Canada between 1994 and 2010 were included in the study. Sleep laboratory clinical data was linked to data from the Institute for Clinical Evaluative Sciences (ICES), which houses administrative data on publicly funded services offered through universal public health insurance in Ontario (Kendzerska et al., 2014). Individuals (N=8,678) were included in the study who did not have diabetes prior to PSG evaluation, and had corresponding administrative datasets. Over the mean follow-up of 67 months, 11.7% of participants (n=1,017) experienced incident diabetes. Cumulative incidence of diabetes for the entire sample was 9.1% (95% CI, 8.4-9.8) at five years. Specifically, the cumulative incidence of diabetes for mild, moderate, and severe OSA was 7.5% (95% CI, 6.3-8.6%), 9.9% (95% CI, 8.3-11.4%), and 14.9% (95% CI, 13.2-16.6%), respectively

(Kendzerska et al., 2014). The unadjusted difference in incidence of diabetes between patients without OSA, and with severe OSA was significant ($p < 0.0001$). The authors of this article claimed their findings were consistent with other proposed pathophysiologic mechanisms, which include "oxidative stress caused by intermittent hypoxemia, sleep deprivation or sleep fragmentation, and sympathetic activation, which may lead to diabetes" (Kendzerska et al., 2014, p. 221). As with the other adverse health conditions associated with OSA, the association between OSA and diabetes is significant.

Research on OSA continues to demonstrate significant adverse health conditions associated with OSA. Understanding of the adverse health conditions associated with OSA provides a foundation for increased OSA screening and recognition. Corresponding to adverse health conditions associated with OSA, the consequences of untreated OSA has been shown to be substantial.

Figure 1.1 Health Conditions Associated with OSA

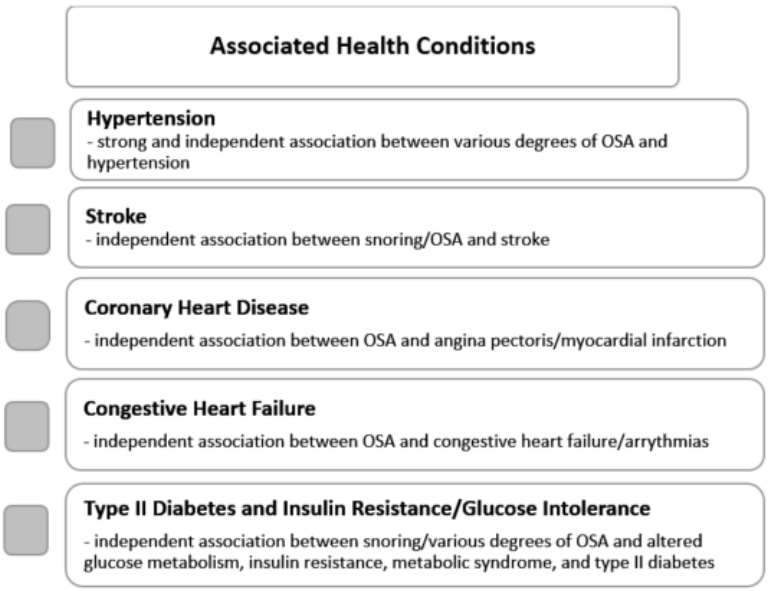

Figure 1.1. Health conditions associated with OSA, including description of association type. Adapted from "Epidemiology of Obstructive Sleep Apnea: a Population-based Perspective" by W. Lee, S. Nagubadi, M. H. Kryger, B. Mokhlesi, 2008, *Expert Rev Respir Med*, 2(3), p. 7-10.

Consequences of untreated OSA. Prominent consequences of untreated OSA include sleep deprivation safety risks and the economic impact of OSA. As OSA is believed to be highly undiagnosed (Lee et al., 2008), the consequences of the untreated condition have the potential to have substantial impact.

Sleep deprivation safety risks. Individuals with untreated OSA are of particular consideration in regards to motor vehicle crashes (MVC). In a 2013 retrospective observational study, the incidence rate of MVC in patients with OSA was investigated (Ward et al., 2013). This study was conducted using data from the West Australian Sleep Health Study for the time period of January 2006 to April 2009. Participants (N=2,673) were individuals referred to a hospital-based sleep clinic to evaluate suspected sleep disordered breathing (Ward et al., 2013). Questionnaire data was collected for each participant, including age, sex, driving experience, MVCs, near-miss MVCs, sleepiness determined by ESS, alcohol consumption, and caffeine consumption. Additionally, each participant underwent a polysomnography (PSG) sleep study to determine a definitive OSA diagnosis (Ward et al., 2013). The overall crash rate of participants was compared with community crash rate data for Western Australia based on the 2006 Office of Road Safety report. This study found a higher crash rate in individuals with untreated OSA, 0.06 MVC/person-year, compared to the crash rate of the general Western Australia community, 0.02 MVC/person-year (Ward et al., 2013). Additionally, this study suggested any severity of untreated OSA was associated with an increased risk of near-miss MVCs in both men and women ($p < 0.001$) (Ward et al., 2013). More specifically, the authors of this study reported a strong association between excessive daytime sleepiness, based on ESS, and reports of near-miss MVCs ($p < 0.001$), regardless of OSA

severity (Ward et al., 2013). A limitation of this study is the potential bias by self-reported crash data of participants.

Similarly, a 2015 research study investigated the associated risk of MVCs in individuals with OSA in Sweden (Karimi, Hedner, Habel, Nerman, & Ludger, 2015). The sample was selected from a population of consecutive clinical patients referred for suspected OSA between 2007 and 2011, whose results were recorded in the European Sleep Apnea Database (ESADA) (Karimi et al., 2015). Of all individuals referred, 65.4% (*N*=1,718) agreed to participate in the study. Data collected for each participant included: body measurements, co-morbidities, smoking, alcohol consumption, driver's license status, average yearly driving distance, ESS, average hours of sleep, AHI, and oxygen desaturation index (ODI). Of those who agreed to participate, 86% (*n*=1,478) of individuals qualified for final analysis based on available driver's license data. The control population (*N*=21,118) consisted of individuals from the general population reported in the Swedish Traffic Accident Data Acquisition (STRADA) registry who had a record of at least one MVC between 2002 and 2012. The control population was proportional to the participant population in regards to location of residency (Karimi et al., 2015). Participants were cross-analyzed with the STRADA registry, which included an observational period starting five years prior to the sleep study, and five years following. This study found strong evidence ($p < 0.001$) to suggest a 2.5-fold increase in MVC risk in patients with OSA, compared to the control population (Karimi et al., 2015). This is comparable to the 3 fold increase in MVC rate found by Ward et al. (2013). Also similar to the study by Ward et al. (2013), the present study suggested that frequency of apnea events did not predict MVC risk, but risk was influenced by excessive daytime

sleepiness, based on ESS. Additionally, Karimi et al. (2015) found use of a continuous positive airway pressure (CPAP) device for at least four hours per night was associated with a reduction of MVCs, from 7.6 to 2.5 MVC/1,000 drivers/year. A limitation of this study is the potential that participants actively seeking sleep studies may be influenced by history of MVC incidents. The studies by Ward et al. (2013) and Karimi et al. (2015) illustrate a prominent risk for MVCs in individuals with OSA, particularly those with excessive daytime sleepiness. As the research by Karimi et al. (2015) suggests, identification and treatment of OSA has the potential to significantly reduce the risk for MVC in patients with OSA.

Economic impact of OSA. In 2016, a report was published by the American Academy of Sleep Medicine (AASM) that addressed the economic impact of OSA (American Academy of Sleep Medicine, 2016). The AASM commissioned Frost & Sullivan to investigate OSA diagnosis, treatment, and its impact on healthcare and workplace economics in the United States (AASM, 2016). Frost & Sullivan have been actively tracking the sleep medicine industry for the last decade, with specific interest in economics as it relates to OSA. For the purpose of the report, the authors interviewed key opinion leaders, reviewed more than 100 leading studies on the impact of OSA, generated financial models, and surveyed 506 patients regarding treatment of their OSA (AASM, 2016). Frost & Sullivan defined direct economic costs as comorbidities, motor vehicle or workplace accidents, and compensating behaviors, such as substance abuse. Indirect economic costs were defined as decreased work productivity, reduced quality of life, and stress on relationships (AASM, 2016). For the purpose of the report, the authors estimated 12% of the U.S. adult population have OSA (29.4 million), and 80% of these

individuals (23.5 million) are undiagnosed (AASM, 2016, p.5). It was estimated undiagnosed OSA cost the U.S. approximately $149.6 billion in 2015 that included comorbidities and mental health, MVCs, workplace accidents, and reduced productivity. Considering only the well-established comorbidities linked to OSA (hypertension, heart disease, diabetes, asthma and other breathing disorders, insomnia, and mental health problems), the cost among the undiagnosed OSA population was approximately $30 billion. Loss of productivity in untreated OSA was estimated to be $86.9 billion. The total economic impact of MVCs where OSA was a contributing factor was estimated to be $26.2 billion. Cost of non-vehicular workplace accidents was estimated to be $6.5 billion (AASM, 2016, p. 4). Additionally, the authors estimated the cost of diagnosing and treating OSA was 33% of the cost of leaving OSA undiagnosed (AASM, 2016, p. 3). It was estimated the cost of diagnosing and treating OSA was $12.4 billion, or $2,105 per person with OSA per year (AASM, 2016, p. 6). Based on these estimates, the authors of this report suggested sleep medicine training must be more prominent in the education of allied health professionals, and improved screening tools should be available for primary care providers (AASM, 2016).

Relevance to oral health professionals. In 2015, *The Journal of Dental Hygiene* published a literature review entitled *Obstructive Sleep Apnea and the Role of Dental Hygienist* (Kornegay & Brame, 2015). In this article, Kornegay & Brame discussed how "dental hygienists are at a pivotal position to discuss risks, characteristics, medical referrals and treatment options for OSA, as well as detect if an individual has OSA thorough questionnaires and other tools that can be done during an examination" (2015, p. 286). This position is partially accounted to research findings indicating of the 24.1%

of adults who did not see a general health care provider in 2008, 23.1% of those individuals did visit a dental office (Strauss, Alfano, Shelley, & Fulmer, 2012). This research suggests a significant proportion of individuals are more likely to see a dentist than a general health care provider. Oral health professionals have the unique opportunity to benefit patients and contribute to interprofessional healthcare by detecting, screening, and referring individuals at high risk for OSA (Kornegay & Brame, 2015). Expanding on the impact of untreated OSA on overall health, the relevance to oral health professionals is further supported by the plausible association between OSA and periodontal disease, as well as the oral manifestations of OSA. Additionally, current OSA educational strategies for health professionals must be identified and assessed to determine if additional OSA education is needed to prepare DHs to screen for OSA.

Association between OSA and periodontal disease. In addition to hypertension, stroke, CAD, CHF, and T2DM, periodontal disease is another potential adverse health condition associated with OSA. A recent systematic review and meta-analysis determined evidence of a plausible association between OSA and periodontal disease (Al-Jewair et al., 2015). The literature search conducted by the authors initially identified 182 relevant articles (N=182). Of the 182 studies, 10 studies had titles and abstracts that met PICOS inclusion criteria. Of the 10 studies, three were excluded due to measuring different outcomes, and one was excluded due to inadequate study design, which left six studies for final analysis (n=6) (Al-Jewair et al., 2015). A total of 30,130 participants were identified (N=30,130), and included adults who were objectively diagnosed as having OSA by an overnight PSG or portable monitor, or adults identified as high-risk for OSA based on self-administered, validated questionnaires (Al-Jewair et al., 2015).

Outcome measurements varied based on how participants were diagnosed with OSA; four studies used AHI as the primary outcome measurement. Periodontal disease outcome measures varied among studies, including: clinical attachment loss, periodontal pocket depth, gingival recession, oral hygiene indices, radiographic bone loss, and salivary cytokines (Al-Jewair et al., 2015). Meta-analysis was conducted on four studies that were combined using the inverse variance random-effects model method. The meta-analysis identified a statistically significant association between individuals identified to have periodontal disease and those diagnosed or at high risk for OSA (pooled odds ratio = 1.65, 95% CI = 1.11, 2.46, $p = 0.01$). Although statistically significant, the results of this systematic review and meta-analysis must be viewed with caution due to the low-level of evidence and wide range of methodological approaches (Al-Jewair et al., 2015). Additionally, although a causative biological mechanism between OSA and periodontal disease has not been identified, the authors of this study summarized hypothesized mechanisms within the reviewed literature, that include: a) periodontal disease causes a chronic inflammatory response that acts as a mediator to OSA inflammation, or vice versa, b) mouth breathing correlated with OSA increases expression of periodontal disease, and c) OSA and periodontal disease share common risk factors and the relationship is not causative (Al-Jewair et al., 2015). Regardless, the plausible association with periodontal disease suggests OSA may be a risk factor for periodontal disease, or vice versa. The implications associated with this correlation constitute relevance to oral health professionals.

Observable Signs and Symptoms of OSA. As several of the signs and symptoms of OSA are observable, including oral manifestations, DHs have a unique opportunity to

recognize individuals at high risk for OSA. In routine appointments, DHs conduct comprehensive evaluations, both intraorally and extra orally. Oral health professionals have the opportunity to identify oral signs and symptoms of OSA that may not be thoroughly assessed by other healthcare professionals.

There are several intraoral traits characteristic to OSA that can be identified during an intra-oral examination. Individuals with OSA may have anterior tooth wear due the tendency to move the mandible forward during an apneic event in an effort to open the airway (Heinrich, 2013). An enlarged tongue with scalloped lateral borders is common, as the enlarged tongue contributes to closing the airway during apneic events, and the scalloped border is characteristic as the individual presses the tongue against the inside surfaces of the teeth (Heinrich, 2013). Acid erosion is characteristic on lingual tooth surfaces as pressure builds in the thoracic area during apneic events, which can push acidic fluids into the oral cavity (Heinrich, 2013). Bruxism, or teeth grinding, is typical in individuals with OSA, which manifests as teeth wear, gingival recession, and abfractions (Heinrich, 2013). Enlarged tonsils are common, as the additional tissue contributes to a restricted airway (Heinrich, 2013). Swelling and redness of the soft palate and anterior gingival tissues is also common, attributed to mouth breathing, and common for individuals with OSA (Heinrich, 2013). Also attributed to mouth breathing, dry mouth is typical, placing individuals at a high risk for dental cavities. Narrow palate and constricted maxillary and mandibular arches are indicative of OSA because the restricted shape of the oral cavity crowds the tongue that is typically pushed back during sleep, thus blocking the upper airway (Heinrich, 2013).

The Mallampati classification is a tool used to classify visibility of the posterior pharynx in patients as they are sitting upright with their mouth open and tongue protruded (Kandray, Juruaz, Yacovone, & Chang, 2013). An increased Mallampati classification correlates to an increased severity of diagnosed OSA (Kandray et al., 2013). See Figure 1.2 for an example of Mallampati classification guide. In 2013, a research study investigated the inter-rater reliability of the Mallampati classification with patients in a DH clinic (Kandray et al., 2013). For this study, a sample of 234 clinic patients (N=234) volunteered to participate in the study. During a 12 month period, Mallampati classifications were performed by 21 DH students, as well as a separate assessment by the clinic dentist. Based on the variance between the DH student and clinic dentist assessment, inter-rater reliability was determined. It was found that DH students, previously educated on the classification system, scored Mallampati classification comparable to that of supervising dentist, with a 77% agreement rate (Kandray et al., 2013). These results suggest the abilities of DHs to determine Mallampati classification with a high agreement rate to the dentist.

As DHs conduct comprehensive evaluations, they also have the opportunity to identify extra-oral signs of OSA. During a routine appointment, the DH can recognize if the patient is obese, a significant risk factor for OSA (Heinrich, 2013). Retrognathic individuals, those with a recessed mandible, are more likely to have OSA than those with normal occlusion, as the malocclusion further constricts the airway (Heinrich, 2013). Additionally, a large neck circumference and chronically chapped lips are also often seen in individuals with OSA. Because an intra-oral and extra-oral evaluation is a common

role of clinical DHs, their ability to recognize observable signs and symptoms of OSA has the potential to become pivotal in screening individuals at high risk for OSA.

Figure 1.2 Mallampati Classification

Mallampati Classification			
Classification	**Anatomy Visible**	**OSA Risk**	**Example**
Class I	Soft palate, entire uvula	Normal	
Class II	Soft palate, portion of uvula	Normal	
Class III	Soft palate, possibly base of uvula	High	
Class IV	Hard palate only, soft palate NOT visible	High	

Figure 1.2. Mallampati Classification is a tool used to classify visibility of the posterior pharynx in patients as they are sitting upright with their mouth open and tongue protruded. Content adapted from "Obstructive Sleep Apnea and the Role of Dental Hygienists" by E. C. Kornegay and J. L. Brame, *The Journal of Dental Hygiene*, 2015, 89(5), p. 287. Images originally published in "Airway Management" by S. Kim, 2007, *J Korean Med Assoc,* 50(12), p. 1050. Images used with permission from Si-Oh Kim, MD.

OSA education of health professionals. In order to contribute to OSA screening efforts, DHs must be knowledgeable of the complex sleep disorder. The Commission on Dental Accreditation (CODA) requires accredited DH programs to include oral health education, preventive counseling, and health promotion in the curriculum (CODA, 2013). As health promotion is a broad concept, it is unclear if the accreditation requirement

incorporates OSA education. Furthermore, DHs may experience OSA education in post-graduate education, such as continuing education modules.

*OSA education in dental hygiene curriculum***.** It is difficult to attribute the low diagnosis rates of OSA to one specific cause. The possibilities are vast, including the cost of definitive diagnosis, lack of concern regarding signs and symptoms, and individuals being unaware of the condition. Furthermore, lack of OSA knowledge in health professionals has the potential to attribute to low diagnosis rates. In 2013, a thesis research study emailed surveys to dental hygiene program directors (*N*=334) to assess sleep medicine content within dental hygiene curriculum (Minichbauer, 2014). A total of 118 dental hygiene programs (*n* = 118) participated in the survey, which was a 35.3% response rate. Despite a relatively low response rate, the author reported statistically significant results and similar response rates of comparable research. From the completed survey responses, it was determined an average of 1.55 hours was devoted to sleep medicine in dental hygiene curriculum, and 32% (*n*=36) of programs reported education of OSA. A total of 57% of schools (*n*=61) reported discussing the association between OSA and periodontal disease, and 18% (*n*=19) reported educating students on the risk factors of OSA. Finally, only 5% of dental hygiene programs (*n*=5) reported teaching the use of OSA screening questionnaires (Minichbauer, 2014). Although the study did not directly discuss why sleep medicine in the DH curriculum is insufficient, the author speculated that with the majority of respondents agreeing sleep medicine is important, implementation is the main obstacle, and alternative methods outside of an already packed didactic schedule should be considered (Minichbauer, 2014). According to the ADHA, there were a total of 328 entry-level DH programs in the United States in

2016 (ADHA, 2016), which is less than the 334 surveys emailed to DH program directors by Minichbauer (2014). Recognizing only 35.3% (*n*=118) of DH program directors at the time of the study participated, it can be inferred OSA education among participating DH programs was insufficient to produce DHs knowledgeable of OSA.

OSA educational intervention in the literature. With minimal OSA education in the DH curriculum (Minichbauer, 2014), additional avenues of educational opportunities merit investigation. In 2014, a study evaluated the effect of an online educational program on nurse practitioners' (NP) knowledge of OSA (Valerio & Heaton, 2014). A convenience sample of NPs (*N*=54) was recruited from the Illinois Society of Advanced Practice Nursing (ISAPN), and from referral of NPs by ISAPN members. Participants were recruited through an email invitation forwarded to ISAPN members by the ISAPN website manager. Only NPs who evaluate and manage adult patients were included in the study. Participants were allowed to choose the location and electronic device in which they would complete the study. The Precaution Adoption Process Model (PAPM) served as the theoretical framework for the study. The PAPM model consists of seven stages: unaware, unengaged, undecided, decided not to act, decided to act, act, and maintenance. Questions regarding participants' PAPM stage for OSA evaluation were used to determine if exposure to the educational intervention would move NPs from lower stages of *unaware* or *unengaged*, to higher levels of *act* or *maintenance*. An identical pretest and posttest was used to determine the effectiveness of the educational intervention in improving NPs knowledge regarding identifying and evaluating adult patients at risk for OSA. The pretest and posttest consisted of 15 case study based questions applicable to main concepts from the educational intervention. The educational

intervention consisted of a 53 minute narrated PowerPoint presentation based on the *Clinical Guideline for the Evaluation, Management, and Long-term Care of Obstructive Sleep Apnea in Adults* (AASM, Adult OSA Task Force, 2009). Topics addressed within the PowerPoint presentation included: OSA prevalence, high-risk conditions, health consequences, OSA signs and symptoms, and evaluation processes and tools. Participants received an email invitation to participate, that lead them to the ISAPN website where they were provided a SurveyMonkey link for the pretest. Participants were first asked if they managed and evaluated adult patients. If participants met the first criteria, they were next asked a PAPM stage question, followed by the pretest, which consisted of three case studies and 15 companion test items. After completing the pretest, participants accessed the PowerPoint presentation via a link provided on the SurveyMonkey site. Once the PowerPoint presentation was viewed, participants returned to the SurveyMonkey site and completed an identical posttest. Additionally, participants answered demographic questions, a question regarding family history of OSA, and a Likert-based question regarding their likelihood of evaluating adult patients for OSA in the future. A power analysis was conducted to determine a minimum sample of 32 participants was needed to achieve 80% power to detect a moderate effect size. Descriptive statistics were generated to characterize the sample and pretest and posttest scores were compared using two-tailed, dependent group, paired *t*-tests. Of the 54 NPs who entered the study, only 70.4% (n=38) completed the entire research protocol. Results demonstrated a statistically significant ($p < 0.001$) increase in post-test scores as compared to pre-test scores (Valerio & Heaton, 2014). Additionally, an average of 1.97 hours of sleep education was reported by participants, comparable to the 1.55 hours

devoted to sleep medicine in the sample of DH programs in the study by Minichbauer (2014). Although this study had several limitations, including small sample size (*N*=54) and a high attrition rate of 29.6%, results suggest an online educational program has the potential to increase OSA knowledge in health professionals. The authors of this study called for further investigation of online OSA educational interventions among various health professions (Valerio & Heaton, 2014). This research and future endorsements support the investigation of a similar OSA educational intervention for DHs.

Effectiveness of online education. If an online OSA education module for DHs is to be considered, evaluating the effectiveness of online education is necessary. In 2013, a meta-analysis was conducted to investigate the effectiveness of online and blended (online and face-to-face) learning (Means, Toyama, Murphy, & Baki, 2013). For this study, literature published from 1996 through July 2008 was searched (*N*=1,132). Initial inclusion criteria included the study addressing online learning, the use of a controlled design, and data being reported on student achievement (Means et al., 2013). A total of 316 articles met the initial inclusion criteria, and 186 additional articles were added from other data sources (Google Scholar, referenced articles, etc.), which yielded a total of 502 articles that underwent full-text screening. Full-text screening criteria required that articles: involve learning that took place over the internet, contrast conditions that varied in terms of use of online learning, describe an intervention study that was completed, report a learning outcome measured for both treatment and control, and use of a controlled design (Means et al., 2013). A total of 176 articles met the full-text screening criteria, and 99 of those articles had at least one contrast between purely online learning and face-to-face learning, or between blended learning and face-to-face learning. Fifty-

four studies did not report sufficient data to support calculating an effect size, thus a total of 45 studies (n=45) were used for data analysis (Means et al., 2013). The meta-analysis of these articles demonstrates that online learning (combination of studies of purely online and of blended learning) on average produced stronger student learning outcomes than learning purely through face-to-face instruction (mean effect size +0.20, $p < 0.001$). Furthermore, the mean effect sizes between purely online versus face-to-face instruction was not significantly different ($p = 0.46$) (Means et al., 2013). The results of this study indicate a blended online and face-to-face instructional style positively influences student learning outcomes, and the student learning outcomes of purely online and face-to-face instruction are not significantly different. This study demonstrates an online module has the potential to be as effective as traditional, face-to-face DH education. With insufficient OSA education reported in a sample of DH programs (Minichbauer, 2014), effectiveness of an online OSA module for NPs (Valerio & Heaton, 2014), and similar student outcomes from purely online learning compared to face-to-face learning (Means et al., 2013), the potential value of an online OSA educational module starts to become apparent.

Core components of OSA education. With insufficient OSA education in many DH curriculums, and the presence of stimulating opportunities for educational interventions, it is important to consider the components of OSA education. Due to the complexity of OSA, multidimensional education is required. As research continues to encompass and represent OSA, the fundamental components needed for an educational intervention must be identified and reviewed. The core components associated with OSA education include risk factors, diagnosis, treatment methods, and screening methods.

Risk factors of OSA. Health promotion relies on the recognition of significant risk factors. In 2008, Lee at al. investigated both modifiable and non-modifiable risk factors associated with OSA. In addition to an OSA predisposition in individuals with associated adverse health condition, various risk factors of OSA have been identified. According Lee et al. (2008), prominent risk factors for OSA include: obesity, aging, male gender, menopause, and African American origin. Other risk factors identified include craniofacial abnormalities, upper airway anatomy, smoking, alcohol, and genetic predisposition (Lee et al., 2008). Obesity, which has a direct relationship with OSA, is one of the most established modifiable risk factors among this condition (Lee et al., 2008). Lee et al. (2008) successfully demonstrates an increased prevalence of OSA correlates with an increase in body measurements (Bixler, Vgontzas, Ten, Tyson, & Kales, 1998; Bixler et al., 2001; Ip et al., 2001; Ip et al., 2004; Young et al., 2002). In regards to aging, the presence of OSA has been found to steadily increase with age, but plateaus around age 65 for reasons that are not well understood (Ancoli-Israel et al., 1991; Bixler et al., 1998; Bixler et al., 2001; Durán, Esnaola, Rubio, & Iztueta, 2001). Additionally, in reviewing large population-based studies, the prevalence of OSA is 1.5 to 3 times greater in men than in women, although OSA prevalence increases with menopausal women (Bearpark et al., 1995; Bixler et al., 1998; Bixler et al., 2001; Durán et al., 2001; Ip et al., 2001; Ip et al., 2004; Kim et al., 2004; Sharma, Kumpawat, Banga, & Goel, 2006a; Young et al., 1993). Lastly, individuals of African American origin have a higher severity of OSA (Ancoli-Israel et al., 1995; Redline et al., 1997). Likewise, the AASM Adult OSA Task Force (2009) identified individuals at high risk for OSA as "those who are obese, those with congestive heart failure, atrial fibrillation, treatment

refractory hypertension, type 2 diabetes, stroke, nocturnal dysrhythmias, pulmonary hypertension, high-risk driving populations, and those being evaluated for bariatric surgery" (p. 264). Dental hygienists conduct routine patient assessments, including taking comprehensive health histories. The DH has the potential to recognize patients with significant risk factors of OSA through health history evaluation, as well as overall assessment of patient characteristics. The ability of DHs to recognize significant risk factors of OSA during routine dental appointment has the potential to positively influence the overall health of patients.

Figure 1.3 OSA Risk Factors

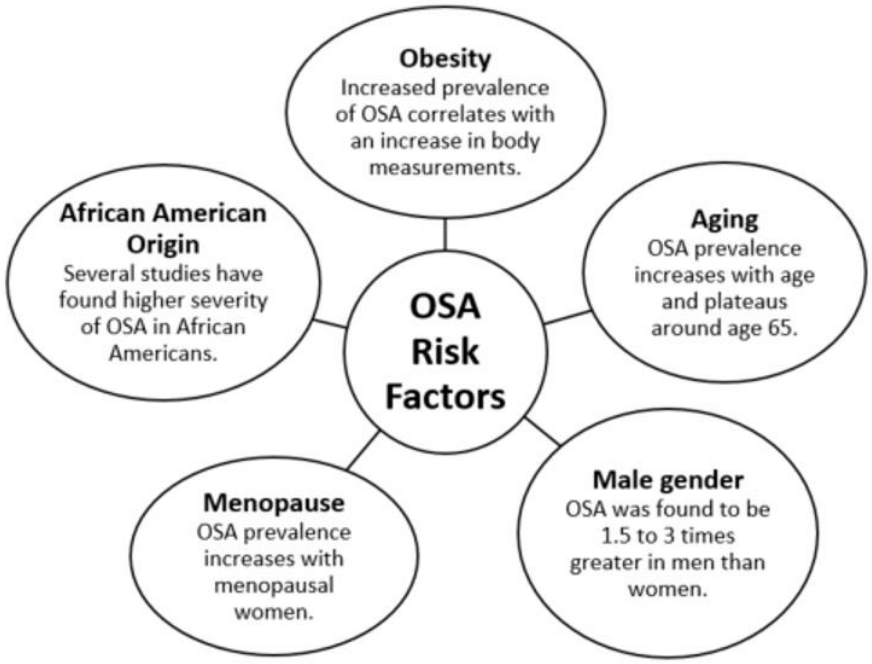

Figure 1.3. Prominent OSA risk factors. Adapted from "Epidemiology of Obstructive Sleep Apnea: a Population-based Perspective" by W. Lee, S. Nagubadi, M. H. Kryger, B. Mokhlesi, 2008, *Expert Rev Respir Med*, 2(3), p. 4-7.

***OSA diagnosis*.** According to the AASM Adult OSA Task Force (2009), individuals at high risk for OSA should have a comprehensive sleep history taken, that includes an evaluation for the following OSA symptoms, "snoring, witnessed apnea, gasping/choking episodes, excessive sleepiness not explained by other factors, including assessment of sleepiness severity by the ESS, total sleep amount, nocturia, morning headaches, sleep fragmentation/sleep maintenance insomnia, and decreased concentration and memory" (p. 264). If OSA symptoms are identified within the sleep history assessment, a definitive diagnostic test is typically indicated. The two most prominent and accepted methods of OSA testing are the polysomnography (PSG) and testing with portable monitors (PMs) (AASM Adult OSA Task Force, 2009).

Polysomnography. The gold standard diagnostic test for OSA is an overnight PSG (AASM Adult OSA Task Force, 2009). During a PSG, physiologic signals are recorded, including: electroencephalogram (EEG), electrooculogram (EOG), chin electromyogram, electrocardiogram (ECG), airflow, oxygen saturation, and respiratory effort (AASM Adult OSA Task Force, 2009), as defined in Figure 1.4. Utilizing the physiologic signals, the frequency of obstructive events is classified using the AHI or the respiratory disturbance index (RDI). Upon completion, a qualified physician evaluates data collected from the PSG to determine if an OSA diagnosis is indicated. If diagnosed, an OSA severity is determined based on the amount of obstructive events per hour (5-14 = mild, 15-29 = moderate, 30+ = severe) (AASM Adult OSA Task Force, 2009). Although a full-night PSG is typically recommended, a split-night study can be considered for an individual demonstrating a high volume of obstructive events early in the study. In a split-night study, the initial diagnostic PSG is followed by continuous

positive airway pressure (CPAP) titration (AASM Adult OSA Task Force, 2009). Continuous positive airway pressure is considered the gold-standard treatment for OSA, and titration entails determining the optimal pressure for maintaining an open upper airway (AASM Adult OSA Task Force, 2009).

Figure 1.4 Physiologic Signals Recorded during Polysomnography

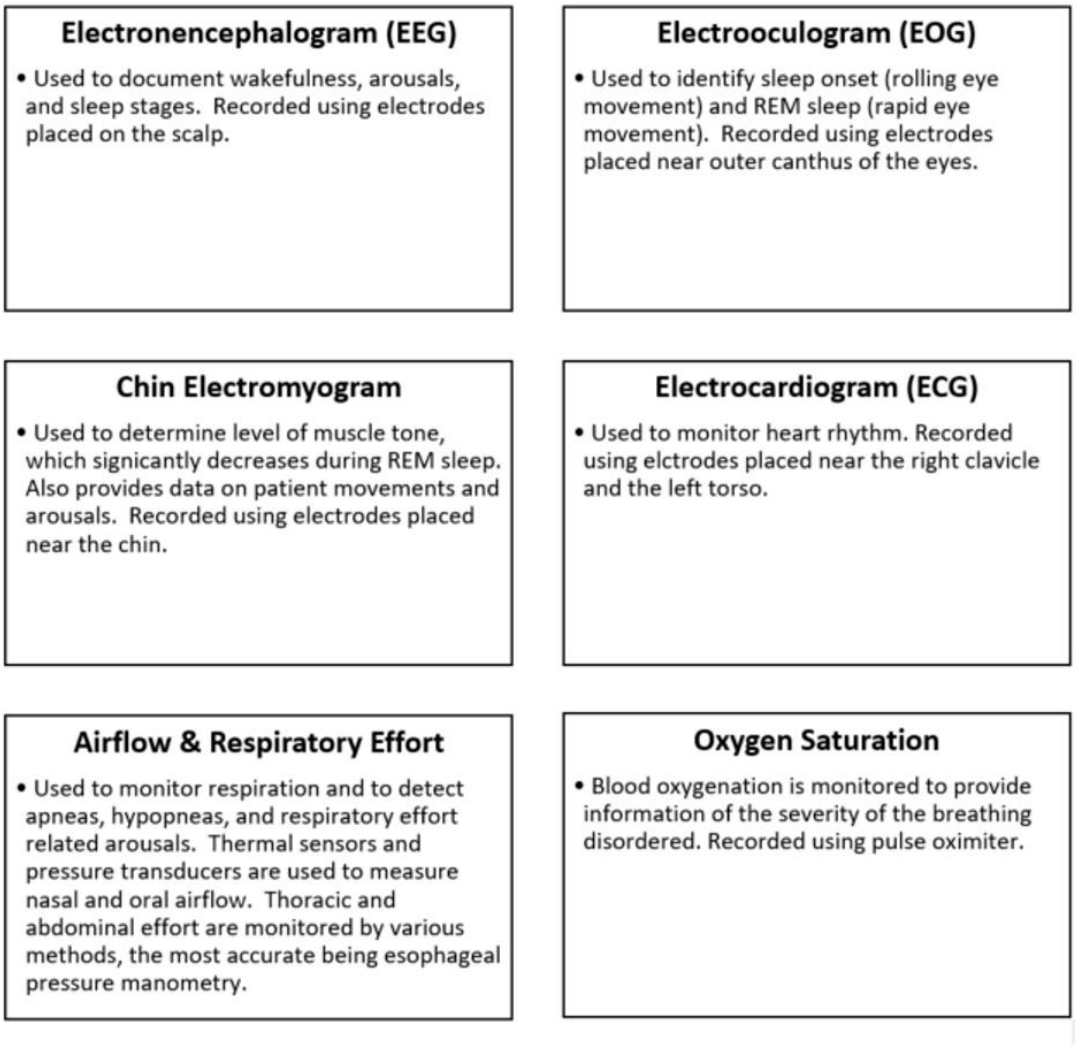

Figure 1.4. Definitions of the physiologic signals that are recorded during PSG testing. Each test should adhere to AASM standards as closely as possible. Adapted from "Sleep Technology: Technical Guide" by the American Association of Sleep Technologists, 2012, p. 2-7. Retrieved from https://go.aastweb.org/Resources/Guidelines/StandardPSG.pdf.

Portable monitor. Despite PSG being the gold standard of OSA diagnosis, PMs are considered a suitable alternative (AASM Adult OSA Task Force, 2009). At minimum, PMs should record airflow, respiratory effort, and blood oxygenation (AASM Adult OSA Task Force, 2009). Portable monitors can be used unattended by individuals with no comorbid medical conditions, such as CHF, CAD, or T2DM, or sleep disorders, such as insomnia. This is providing the patient has been thoroughly educated on the sensor application process by a trained healthcare professional. The frequency of obstructive events is reported similar to PSG, but PMs are more likely to underestimate the severity of events (AASM Adult OSA Task Force, 2009). Both the PSG and PM are acceptable methods of OSA diagnosis and the decision between methods is considered on a case-by-case basis.

Treatment methods. Once a sleep study has concluded a diagnosis of OSA, it becomes necessary to consider appropriate avenues of treatment. Research has been conducted on OSA treatment options. In 2013, the American College of Physicians (ACP) created the clinical practice guideline, *Management of Obstructive Sleep Apnea in Adults: A Clinical Practice Guideline from the American College of Physicians* (Qaseem et al., 2013). Within this guideline, levels of evidence were graded using the ACP clinical practice guidelines grading system (Qaseem et al., 2013). The most prominent treatment options identified include positive airway pressure (PAP) devices, oral devices, and surgical treatment.

*Positive airway pressure***.** Positive airway pressure devices utilize compressed air to maintain an open airway, and are available in several variations, including continuous (CPAP), bi-level (BPAP), or auto-titrating (APAP). All positive airway pressure devices

utilize compressed air to provide a pneumatic splint of the upper airway, but devices vary in how compressed air pressure is controlled (AASM Adult OSA Task Force, 2009). In CPAP machines, air is delivered at one consistent pressure throughout the entire night. In BPAP machines, the device is designed to reduce difficulty in exhaling against the fixed pressure by delivering a lower pressure during exhalation. Auto-titrating machines (APAP) work similarly to CPAP machines because they deliver one consistent pressure, but the machine automatically titrates to determine what pressure is needed to maintain an open upper airway (AASM Adult OSA Task Force, 2009). Additionally, nasal, oral, or oronasal masks are available, and expiration pressure relief and humidification may be added to increase patient comfort (AASM Adult OSA Task Force, 2009). In the ACP clinical practice guidelines, moderate evidence based on 22 research studies illustrated PAP devices to be superior to no treatment, with a AHI score difference of -19.85 events/hour ($p < 0.001$) (Qaseem et al., 2013). Moderate evidence from 21 research studies suggested the CPAP and APAP devices are equally effective with an AHI score difference of 0.23 events/hour ($p = 0.268$); however, the ACP clinical practice guidelines reported insufficient evidence to suggest a difference in effectiveness between the BPAP and CPAP (Qaseem et al., 2013). Additionally, there was insufficient evidence to determine whether the oral or nasal mask is more effective and insufficient evidence to determine a benefit of added humidification (Qaseem et al., 2013). Although PAP devices have proven to be effective in treating OSA, patient compliance concerns warrants investigation of treatment alternatives, such as oral devices.

Oral devices. Oral devices are also effective in enlarging the upper airway and decreasing upper airway collapsibility, thus allowing air intake and outflow (AASM

Adult OSA Task Force, 2009). According to the AASM, oral devices are recommended for individuals with mild to moderate OSA who demonstrate poor adherence to PAP devices or have a preference for oral devices (AASM Adult OSA Task Force, 2009). The most common oral device is the mandibular advancement device (MAD). The MAD fits over both the upper and lower teeth, and is connected by a metal hinge. The device pushes the lower jaw and tongue slightly forward, preventing the upper airway from collapsing during sleep (AASM Adult OSA Task Force, 2009). Prior to treatment, the presence and severity of OSA must be verified by PSG or PM to determine the potential effectiveness of treatment with oral devices (AASM Adult OSA Task Force, 2009). In preparation for an oral device, patients should have a dental examination that includes an evaluation of dental history and an intra-oral, soft tissue, periodontal, and temporomandibular joint (TMJ) evaluation. Additionally, the patient should be assessed for any parafunctional habits, such as nocturnal bruxism, or teeth grinding (AASM Adult OSA Task Force, 2009). Although the ACP clinical practice guideline found moderate evidence based on 10 research studies suggesting MADs are less effective than PAP devices in treating OSA with a AHI score difference of +7.7 events/hour ($p < 0.001$), the guideline also found moderate evidence from 5 research studies to suggest MADs are more effective than no treatment with an AHI score difference of -11 events/hour (*p*-value not reported) (Qaseem et al., 2013).

Additionally, a 2013 randomized crossover trial compared the health outcomes of CPAP versus oral appliance treatment for OSA (Phillips et al., 2013). This study was conducted at three sleep centers in Sydney, Australia. To be included in the study, patients had to be newly diagnosed with OSA (AHI > 10), at least 20 years old, have at

least two symptoms of OSA (snoring, fragmented sleep, witnessed apnea, or daytime sleepiness), and have a willingness to use both CPAP and a MAD. Patients were excluded if they had previous OSA treatment, a need for immediate OSA treatment, central sleep apnea, a coexisting sleep disorder, regular use of sedatives or narcotics, a preexisting lung or psychiatric disease, or any contraindications for oral devices, including periodontal disease or insufficient teeth (Phillips et al., 2013). Dental eligibility was determined by an orthodontist at the Sydney Dental Hospital. A total of 177 patients were assessed for eligibility (N=177), 126 participants (n=126) entered the study, and 108 (n=108) completed the entire research protocol (Phillips et al., 2013). Participants went through a 4-6 week acclimatization phase for both the CPAP and MAD, and then a month long treatment phase for each treatment, with a 2 week washout phase in between. The sequence of the acclimation phase and the treatment phase was randomized (Phillips et al., 2013). From this study, CPAP was once again shown to be more effective in reducing AHI (CPAP AHI, 4.5 $\pm$ 6.6/hour; MAD AHI, 11.1 $\pm$ 12.1/hour; $p < 0.01$), but compliance with MAD was reported higher than with CPAP (MAD, 6.50 + 1.3 hour/night vs. CPAP, 5.2 + 2 hours/night; $p < 0.00001$). Although blood pressure was not significantly improved with either treatment, sleepiness, driving simulator performance, and disease-specific quality of life improved with both the CPAP and MAD, and by similar amounts ($p < .05$) (Phillips et al., 2013). The authors suggested the greater efficacy of PAP may be offset by inferior compliance compared to MAD. This may account for similar effectiveness in regards to health outcomes. This article suggested MAD should be considered for individuals with moderate to severe OSA (Phillips et al., 2013). Despite evidence suggesting the effectiveness of PAP and oral

devices in treating OSA (Qaseem et al., 2013), surgical treatment may also be considered as an alternative for individuals who are ineligible or uncompliant for treatment with PAP or oral devices.

Surgical treatment. Surgical treatment can be effective for individuals with mild OSA who have severe obstructing anatomy, or when treatment with PAP devices or oral devices is insufficient (AASM Adult OSA Task Force, 2009). There are procedures that may be effective in reducing or eliminating OSA symptoms including: uvulopalatopharyngoplasty (UPP), hyoid suspension, hypoglossal nerve stimulator, radiofrequency volumetric tissue reduction, septoplasty and turbinate reduction, lingual tonsillectomy, midline glossectomy and base of tongue reduction, genioglossus advancement (GGA), anterior inferior mandibular osteotomy (AIMO), and maxillomandibular osteotomy (MMO) and maxillomandibular advancement (MMA) (The Cleveland Clinic Foundation, 2014). See Figure 1.5. In a review of surgical treatment options published in a 2010 edition of *Military Medicine,* the significance of a detailed pre-surgical evaluation for individuals considering surgical treatment was discussed. As obstruction is most often caused by multiple obstruction sites, the pre-surgical evaluation should include a radiographic evaluation of the position of the hyoid bone, soft palate length, posterior airway space, and position of the mandible (Powers, Allan, Hayes, & Michaelson, 2010). Additional considerations would include the Friedman Classification (Mallampati Grade and tonsil size) and the Fujita Classification (site of obstruction) (Powers et al., 2010). Although there is insufficient evidence to compare surgical treatment to PAP or oral devices, surgery provides an alternative option for individuals in which traditional treatment was ineffective (Qaseem et al., 2013).

Figure 1.5 Surgical Procedures for OSA

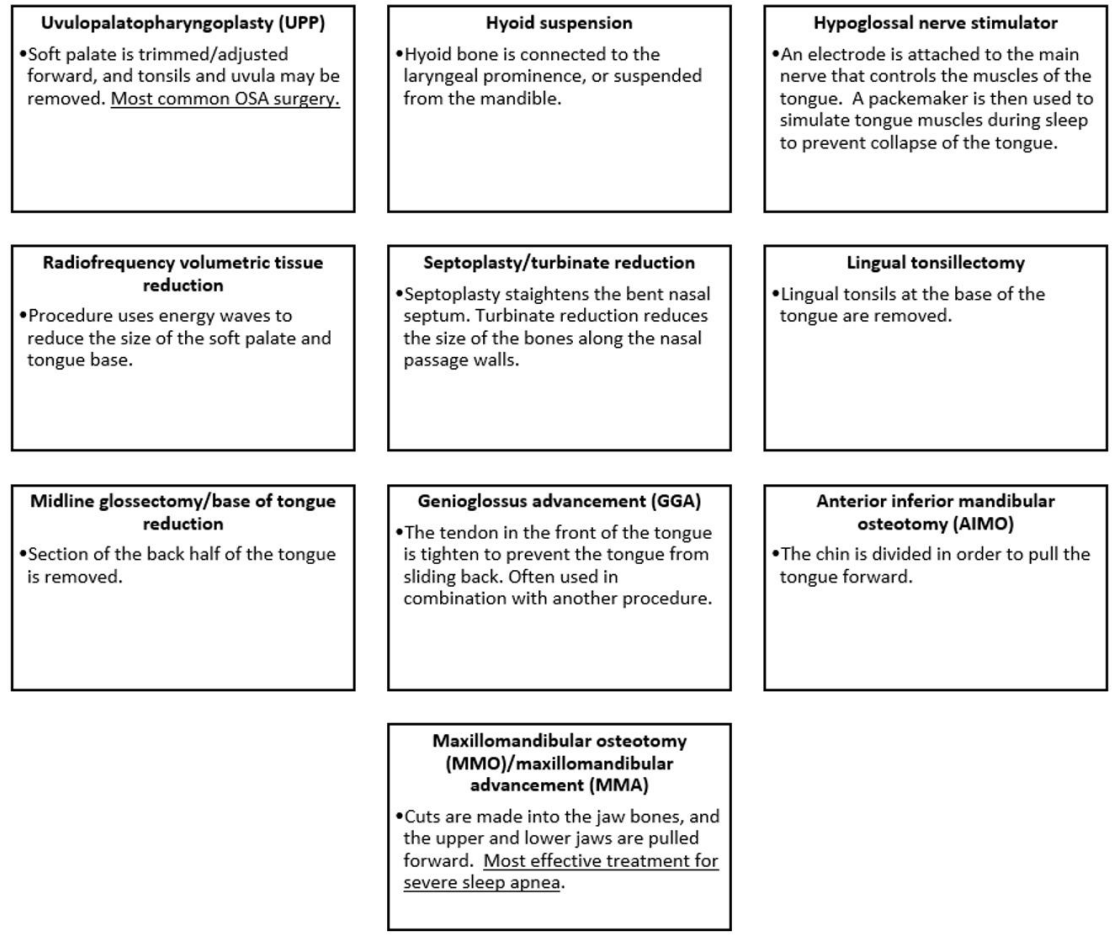

Figure 1.5. Common surgical procedures used to treat OSA. Procedures are intended to open the airway and prevent apneas or hypopneas. Adapted from "Diseases & Conditions: Surgery for Sleep Apnea" by The Cleveland Clinic Foundation, 2014. Retrieved from http://my.clevelandclinic.org/health/diseases_conditions/hic_Common_Sleep_Disorders/hic-surgery-for-sleep-apnea

Screening methods. There are several screening methods available to identify individuals at high risk for OSA. Dental hygienists who are knowledgeable of OSA might have the ability to contribute to screening efforts. A recent meta-analysis of 26 relevant studies evaluated clinical screening tools for OSA (Ramachandran & Josephs, 2009). To be included in the study, the diagnostic value of each OSA questionnaire had to be compared with an observed, standard overnight PSG. Although the review provides

valuable insight on screening methods, a limitation to consider is that the diagnostic odds ratio (DOR) demonstrated poor reproducibility in several validation studies (Ramachandran & Josephs, 2009). In addition, a systematic review of 10 studies specifically regarding screening questionnaires for OSA was conducted in 2010 (Abrishami, Khajehdehi, & Chung, 2010). To be included within the review, studies had to evaluate patient-based questionnaires for adult OSA and determine accuracy by comparing with PSG results (Abrishami et al., 2010). Similar to the meta-analysis, a limitation of this systematic review was the inconsistency of results between included studies (Abrishami et al., 2010). Due to this inconsistency, there is currently no consensus from the American Society of Anesthesiologists (ASA) or the AASM on the best screening method of OSA. However, prominent methods in the systematic review and meta-analysis articles included the Berlin Questionnaire (BQ), Epworth Sleepiness Scale (ESS), the STOP-BANG questionnaire, and the Wisconsin Sleep Questionnaire (WSQ) (Abrishami et al., 2010; Ramachandran & Josephs, 2009). The results of the systematic review and meta-analysis are summarized in Figure 1.6.

Berlin Questionnaire (BQ). The BQ consists of three categories and a total of 10 questions. Each category is scored separately based on specified scoring criteria. An individual is determined to be high risk if two are more categories are scored as "positive." See Appendix A for a copy of the BQ. Characteristics of the BQ are summarized in Figure 1.7. In the meta-analysis of screening methods, the BQ was found to be the most accurate questionnaire for predicting diagnosis of OSA (Ramachandran & Josephs, 2009). This is consistent with the systematic review that found the BQ to have the highest specificity of questionnaires for patients without history of sleep disorders and

all ranges of OSA severity (Abrishami et al., 2010). Additionally, a prospective study was conducted in 2014 that evaluated the predictive value of the BQ and ESS for OSA (Ulasli et al., 2014). This study administered a BQ and ESS on 1450 participants in a Turkish sleep clinic prior to a one night PSG evaluation (Ulasli et al., 2014). It was determined that the BQs in this study had a sensitivity of 80.3% for AHI values greater than 30, and a sensitivity of 76.4% for AHI values greater than 15 (Ulasli et al., 2014). It can be concluded from these studies that the BQ is an accurate questionnaire for predicting OSA, particularly in severe OSA (Abrishami et al., 2010; Ramachandran & Josephs, 2009; Ulasli et al., 2014).

Epworth Sleepiness Scale (ESS). The ESS is likely the most common OSA screening method and consists of a total of 8 questions, each of which is scored equally. Using a Likert-type scale, the probability of falling asleep in different conditions is rated from 1-3 (low = 1, moderate = 2, high = 3). A total score of 10 or higher indicates excessive daytime sleepiness and a high probability of OSA (Ulasli et al., 2014). See Appendix B for a copy of the ESS. Characteristics of the ESS are summarized in Figure 1.7. Despite the popularity of this screening method, the meta-analysis of screening methods indicated the ESS was the least accurate questionnaire for predicting a diagnosis of OSA (Ramachandran & Josephs, 2009). The prospective study of the predictive value of the BQ and ESS also demonstrated the ESS having a low sensitivity for OSA (Ulasli et al., 2014). Interestingly, the authors of the prospective study discovered the highest specificity of OSA was found when the BQ and ESS were used together. Although a poor indicator of OSA individually, the ESS appeared to increase the sensitivity of the BQ for individuals with an AHI below 15 (Ulasli et al., 2014).

STOP-BANG Questionnaire. The STOP-BANG Questionnaire was developed in 2008 and contains four subjective (STOP: **S**noring, **T**iredness, **O**bserved apnea, and High blood **P**ressure) and four demographic (BANG: **B**MI, **A**ge, **N**eck circumference, and **G**ender) questions (Nagappa et al., 2015). See Appendix C for a copy of the STOP-BANG Questionnaire. Characteristics of the STOP-BANG questionnaire are summarized in Figure 1.7. An individual is considered high risk if they answer yes to three or more of the total eight questions. In a 2015 systematic review and meta-analysis, research articles (*N*=342) from 2008 to January 2015 concerning the use of the STOP-BANG questionnaire on adults was reviewed (Nagappa et al., 2015). To be included in the review (*n*=17), the accuracy of the questionnaire had to be validated by PSG and OSA had to be defined by AHI or RDI. From this review it was determined that a STOP-BANG score of three or greater demonstrated OSA sensitivity of 83.9% for AHI scores greater than 5, 92.9% for AHI scores greater than 15, and 100% for AHI scores greater than 30 (Nagappa et al., 2015). Additionally, the meta-analysis of screening methods indicated that the STOP-BANG questionnaire was identified as an excellent screening method of severe OSA, which is consistent with the systematic review that identified the questionnaire as the most sensitive questionnaire for individuals without history of sleep disorders with moderate to severe OSA (Abrishami et al., 2010; Ramachandran & Josephs, 2009).

Wisconsin Sleep Questionnaire (WSQ). Lastly, the WSQ was originally developed as part of the Wisconsin Sleep Cohort Study and included questions on sociodemographics, lifestyle, health habits, and sleep characteristics (Young, 2009). The questionnaire determines if individuals are habitual snorers based on questions regarding

habitual snoring, loud snoring, and breathing pauses during sleep (Abrishami et al., 2010). Individuals are considered high risk for sleep disordered breathing if they report snoring sometimes (or more frequently), snoring loudly, or witness breathing pauses (Young, 2009). Characteristics of the WSQ are summarized in Figure 1.7. Since the original study publication in 1993, the WSQ has been reformed for various studies, such as a study by Sharma in 2006 to assess prevalence and risk factors of OSA in New Delhi, India (Sharma, Kumpawat, Banga, & Goel, 2006b). Due to the various versions and limited established use in clinical settings, a copy of the WSQ was not located. Despite the apparent unavailability for use in clinical practice, the WSQ was found to have the highest sensitivity for OSA with an AHI/AI or RDI $\geq$ 5 in individuals without history of sleep disorders (Abrishami et al., 2010). The WSQ, as well as the other screening questionnaires discussed, have the potential to identify individuals with OSA.

Figure 1.6. Quality of OSA Screening Methods

	Systematic Review (Abrishami et al., 2010) (individuals without history of sleep disorders)			**Meta-Analysis (Ramachandran & Josephs, 2009)**
	Slight OSA (AHI/AI or RDI $\geq$ 5)	**Moderate OSA** (AHI/AI or RDI $\geq$ 15)	**Severe OSA** (AHI/AI or RDI $\geq$ 30)	
Berlin Questionnaire (BQ)	Highest specificity (74% pooled)	Highest specificity (44% pooled)	Highest specificity	Most accurate questionnaire for predicting OSA diagnosis
Epworth Sleepiness Scale (ESS)				Least accurate questionnaire for predicting OSA diagnosis
STOP-BANG Questionnaire		Highest sensitivity (77% pooled)	Highest sensitivity	Excellent method for predicting severe OSA
Wisconsin Sleep Questionnaire (WSQ)	Highest sensitivity (83% pooled)			

Figure 1.6. The BQ, ESS, STOP-BANG questionnaire, and WSQ were evaluated for specificity, sensitivity, and overall accuracy. Summary of results from a systematic review and a meta-analysis are depicted. Adapted from "A systematic review of screening questionnaires for obstructive sleep apnea" by A. Abrishami, A. Khajehdehi, F. Chung, 2010, *Can J Anesth/J Can Anesth*, 57, 423-438, and "A Meta-Analysis of Clinical Screening Tests for Obstructive Sleep Apnea" by S. K. Ramachandran and L. A. Josephs, 2009, *Anesthesiology*, 110(4), 928-939.

Figure 1.7. Characteristics of OSA Screening Questionnaires

	Description of Questionnaire	Scoring Method
Berlin Questionnaire (BQ)	Three categories (snoring, tiredness, high blood pressure) with a total of 10 questions.	Each category is scored separately based on scoring criteria. High risk if 2-3 categories are scored as "positive."
Epworth Sleepiness Scale (ESS)	Total of 8 questions regarding the probability of falling asleep in different conditions.	Likert-type scale (low = 1, moderate = 2, high = 3). High risk if total score is 10 or greater.
STOP-BANG Questionnaire	Contains four subjective (STOP: **S**noring, **T**iredness, **O**bserved apnea, and high blood **P**ressure) and four demographic (BANG: **B**MI, **A**ge, **N**eck circumference, and **G**ender) questions.	High risk if three or more questions are answered as "yes."
Wisconsin Sleep Questionnaire (WSQ)	Questions regarding habitual snoring, loud snoring, and breathing pauses during sleep.	High risk if individuals report snoring sometimes (or more frequently), snoring loudly, or witness breathing pauses.

Figure 1.7. Summary of the characteristics of the BQ, ESS, STOP-BANG questionnaire, and the WSQ. Each screening method varies in design and scoring criteria. Adapted from "Predictive value of Berlin Questionnaire and Epworth Sleepiness Scale for Obstructive Sleep Apnea in a Sleep Clinic Population" by S. S. Ulasli, E. Gunay, T. Koyuncu, O. Akar, B. Halici, S. Ulu, and M. Unlu, 2013, *Clin Respir J*, 2014, 8, 292-296; "Validation of the STOP-BANG Questionnaire as a Screening Tool for Obstructive Sleep Apnea Among Different Populations: a Systematic Review and Meta-Analysis" by M. Nagappa, P. Liao, J. Wong, D. Auckley, S. K. Ramachandran, S. Memtsoudis, B. Mokhlesi, and F. Chung, 2015, *PLoS ONE*, 10(12), 1-21; and "Rationale, Design, and Findings from the Wisconsin Sleep Cohort Study: Toward Understanding the Total Societal Burden of Sleep Disordered Breathing" by T. Young, 2009, *Sleep Med Clin*, 4(1), 37-46.

Summary (Significance of the Study)

OSA is a common sleep disorder that has recently gained the attention of oral health professionals, due to the high prevalence, low diagnosis rate, and various risks associated with the untreated condition (Lee et al., 2008). Considering OSA is associated with several adverse health conditions impacting systemic health (Lee et al., 2008), it is logical for DHs to contribute to screening efforts. Since existing research indicates insufficient OSA education being incorporated into the DH curriculum (Minichbauer, 2014), an educational interventions may provide an opportunity to increase the OSA knowledge of DHs (Minichbauer, 2014). A comprehensive educational intervention

includes background OSA information (prevalence, risk factors, etc.), OSA diagnosis and treatment content, and information regarding OSA screening methods (BQ, ESS, STOP-BANG questionnaire and WSQ).

While the importance of screening for OSA is well established, it is necessary to investigate potential avenues of educational interventions for DHs. Considering an online OSA training was found to be effective for NPs (Valerio & Heaton, 2014), a comparative educational intervention warrants further investigation for DHs. With a high prevalence and low diagnosis rate (Lee et al., 2008), DHs trained in OSA screening have the potential to identify undiagnosed individuals at high risk for OSA. Dental hygienists have a unique opportunity to conduct a comprehensive evaluation of patients, both orally and systemically. In addition to conducting routine assessments, DHs typically spend considerable time with patients, and within a close proximity. The evidence of a plausible association between OSA and periodontal disease (Al-Jewair et al., 2015) further establishes strong relevance for DHs to include screening for OSA in their routine oral assessments. An online educational intervention for DHs has potential to provide insight toward probable, holistic benefits for patients as a result of increased screening.

Methodology

Research Method or Design

A mixed method, one-group, pre-test/post-test design was used to determine if an online educational intervention increased DH students' knowledge of information relevant to OSA screening. With an educational intervention being experimental in nature, and a control group and randomization being infeasible due to time and resource restraints, this research design was appropriate. A disadvantage to this design was the inability to guarantee that change in knowledge was the result of the educational module, due to a lack of control group. An advantage of the design was the ease of administration and feasibility.

Procedures

Human subjects' protection/informed consent. Institutional review board (IRB) was obtained at EWU. Minimal risk was anticipated for participation in the proposed research study, which was approved as *exempt*. To assure anonymity, SurveyMonkey© settings was set to "anonymous responses," which eliminated personally identifiable data from survey results. All data exported from SurveyMonkey© was kept in a password-protected computer only accessible by the researcher.

Sample source, plan, sample size, description of setting.

Sample source. For pragmatic purposes, a convenience sample source was used. The target population was students in a CODA accredited DH program. The sampling frame included students enrolled in the DH program at Eastern Washington University

(EWU). The EWU DH program is a two-year program, including five semesters and an eight-week summer semester between the first and second year. A summary of the EWU course schedule is included in Figure 2.1. Upon completion, EWU graduates earn a Bachelor of Science in Dental Hygiene (BSDH). Currently, the EWU DH program admits 40 students each fall. At the time of the study, the researcher was enrolled as a Master of Science in Dental Hygiene (MSDH) student at EWU, but had no academic influence on participants. Due to the nature of convenience sampling, results were not generalizable as it was unknown if the sample was representative of the entire DH student population (Bryman, 2012).

Figure 2.1 EWU Course Schedule

1st Year of Study	
Fall Semester	**Spring Semester**
DNHY 301S – Dental Anatomy	DNHY 350S – Clinic I
DNHY 310S – Radiology	DNHY 320S – Pharmacology
DNHY 300S – Head and Neck Anatomy	DNHY 321S – Periodontology I
DNHY 330S – Pre-Clinic	DNHY 341S – Management of Medically Compromised
DNHY 302S – Histology and Embryology	DNHY 380S – Restorative Dentistry
DNHY 360S – Disease Prevention Strategies	
DNHY 477S – Leadership & Professional Development	

Summer Semester
DNHY 450S - Clinic II
DNHY 421S – Pain Management

2nd Year of Study	
Fall Semester	**Spring Semester**
DNHY 451S – Clinic III	DNHY 452S – Clinic IV
DNHY 480S – Restorative Dentistry II	DNHY 481S – Restorative Dentistry III
DNHY 430S – General and Oral Pathology	DNHY 490S – Dental Hygiene Capstone
DNHY 441S – Special Populations	DNHY 484S – Principle of Advocacy and Ethics
DNHY 470S – Research	DNHY 454S – Strategies in Risk and Practice Management
DNHY 442S – Periodontology II	DNHY 461S – Experiences in Dental Public Health
DNHY 460S – Dental Public Health	
Choice of one elective:	
DNHY 475S – Clinical Education Strategies	*DNHY 475S – Clinical Education Strategies*
DNHY 446S – Advanced Perio	*DNHY 446S – Advanced Perio*
	DNHY 482S – Advanced Restorative

Figure 2.1. Current EWU Course Schedule, as of the 2016-2017 academic year. The EWU DH program is a two-year semester program, including an eight-week summer semester between the first and second year.

Plan. Inclusion criteria for participation in this study included enrollment in DNHY 341S Management of the Medically Compromised, a course in the EWU dental hygiene first year, second semester curriculum. Only first year DH students were selected for participation in an effort to ensure the standardization of participants' academic DH experience. The topic of OSA is included in the DNHY 341S course objectives. Although this did not control for previous OSA knowledge of participants, it eliminated participants from receiving formal OSA education within the DH program prior to participation in the study.

The OSA educational module was required as DH course content for sleep medicine, but consent to the use of anonymous assessment data for research and publication purposes was voluntary. This course unit was weighted equally to other units, and was suitable for the *flipped classroom* pedagogy utilized in DNHY 341S. The *flipped classroom* is a pedagogical model in which the traditional lecture and homework components of a course are reversed. Students complete readings or view videos prior to class to gain a background knowledge of a topic, and traditional class time is devoted to active learning strategies (Educause, 2012). Prior to implementation, the instructor of DNHY 341S assigned students a random identification number. The primary investigator (PI) did not have access to the data that corresponded students' names to identification numbers. Students were asked to provide their identification number for each SurveyMonkey© assessment, which facilitated the grouping of assessments per participants. SurveyMonkey© assessments included a pre-test, demographic questionnaire, post-test, program evaluation, and an identical second post-test. Results

from the first post-test were exported from SurveyMonkey© and forwarded to the course instructor, who assigned student grades.

Canvas© learning management system (LMS) facilitated the delivery of the online module. The course instructor for DNHY 341S created an OSA module within Canvas©, which included the SurveyMonkey© and YouTube links for the study. A copy of the Canvas© OSA module content is included in Appendix O. Students were asked in the pre-test if they consented for their anonymous assessment data to be used for research and publication purposes. A copy of the informed consent statement is included in Appendix F. As an incentive for participation, pizza was to be provided during DNHY 341S if all eligible students consented to the research study and completed the entire research protocol. Due to incomplete consent for the research study and the need to extend deadlines for both the first and second post-test to encourage participation, the pizza incentive was not provided. However, cookies were brought to DNHY 341S students as a thank you for those who did consent and participate.

Size. All first year DH students at EWU (N=40) were invited to participate. For results to have 80% power with a 95% confidence level, it was calculated that 32 participants (n=32) were necessary.

Description of the setting. This proposed study was conducted at EWU. This setting was ideal for the study as the educational institution has a DH program and existing faculty acquaintances. Dental hygiene students are familiar with the educational setting and were likely more willing to participate in the research study than DHs in private practice. Additionally, existing Canvas© LMS was used to facilitate delivery of the online module.

Variables.

***Independent variable*.** The independent variable of the proposed research was an online OSA educational module based on existing research literature. The educational module developed for this research study contained OSA educational content, including: prevalence, consequences of the untreated condition, risk factors, oral manifestations, definitive diagnosis, treatment options, screening methods, and OSA case studies (Appendix O). Within the Canvas© module, a PowerPoint presentation containing three researcher-developed videos demonstrating the use of the BQ, ESS, and STOP-BANG Questionnaire was viewed by participants. Similarly, the educational module used by Valerio & Heaton (2014) contained content on OSA prevalence, high-risk conditions, health consequences, OSA signs and symptoms, and evaluation process and tools. The topical outlines of the OSA educational modules for the current study and for the study by Valerio and Heaton (2014) is provided in Figure 2.2.

Dependent variable. The dependent variable of the proposed research was OSA knowledge, as assessed by a researcher developed pre-test/post-test questionnaire.

Instruments. The pre-test/post-test and educational module was designed by the researcher due to absence of existing content related to DHs role in assessing for OSA. The pre-test/post-test format consisted of 17 multiple choice items, including questions based on two case studies. The pre-test and post-test was identical, with exception of one Likert-type item and two open-ended questions added to the first post-test. To establish content validity, the researcher-developed pre-test/post-test and educational module was reviewed by the thesis committee for this thesis study, all MSDH graduate faculty at EWU, and an OSA content expert. It is important to note that causality could not be

determined as the research design lacked control groups. A copy of the pre-test/post-test is attached in Appendix E.

Figure 2.2 Topical Outlines of OSA Educational Modules

Topical Outline of OSA Educational Module – Current Research Study		
PowerPoint Slide(s)	**Topic**	**Subtopic(s)**
1-4	Introduction/What is OSA?	Learning objectives, definition of OSA, OSA classification, and common symptoms
5-17	OSA Background Information	Associated health conditions, potential consequences of untreated condition (economic impact, sleep deprivation safety risks, and mental health/depression), risk factors, and epidemiology
17-25	Relevance to Oral Health Professionals	Periodontal disease & OSA, observable signs & symptoms
26-28	OSA Methods of Definitive Diagnosis	Polysomnography and portable monitors
29-33	OSA Treatment Options	Positive airway pressure, oral devices, and surgical treatment
34-48	OSA Screening Methods	Berlin Questionnaire, Epworth Sleepiness Scale, STOP-BANG Questionnaire, Wisconsin Sleep Questionnaire, video demonstration of screening methods, capability of DH to screen, OSA referral process
49-53	OSA Case Study	OSA case study utilizing screening questionnaires

Topical Outline of OSA Educational Module – Valerio & Heaton (2014)		
PowerPoint Slide(s)	**Topic**	**Subtopic(s)**
2-4	Obstructive Sleep Apnea (OSA)	Define OSA, Clinical population under diagnosis
5-9	High-risk conditions	Cardiovascular, endocrine, and neurovascular conditions, motor vehicle crashes, preoperative
10-17	Health consequences	Morbidity, mortality safety, quality of life
18-21	OSA symptoms	Nighttime symptoms, daytime symptoms, functional issues
22-27	OSA signs	Body habitus, blood pressure, facial features, airway features
28-36	Evaluation process and tools	Screening plan, differential diagnosis, routine health evaluation, high-risk conditions, screening tools
Note. Slide 1: title and introduction; slides 33-34: Berlin Questionnaire; slide 35: STOP-BANG tool; slides 37-39: references		

Figure 2.2. Topical outline of the OSA educational module created for the current research study, and the topical outline of the OSA educational module used by Valerio and Heaton (2014). Valerio and Heaton (2014) topical outline adapted from "The Effects of an Online Educational Program on Nurse Practitioners' Knowledge of Obstructive Sleep Apnea in Adults" by T. D. Valerio and K. Heaton, 2014, *Journal of the American Association of Nurse Practitioners*, 26, p. 603-611.

This format allowed for a statistical evaluation of gained knowledge and was adapted from the pre-test/post-test utilized in the research of an OSA educational module for NPs (Valerio & Heaton, 2014). Consent to adapt the pre-test/post-test and utilize a similar research design was granted by Valerio and Heaton. A copy of the email from

the author is included as Appendix D. The pre-test/post-test used by Valerio & Heaton (2014) consisted of 15 multiple choice items, including three case studies, and one post-test Likert-type item regarding the likelihood of screening for OSA. A copy of the pre-test/post-test used by Valerio and Heaton (2014) is attached in Appendix J. Furthermore, the same Likert-type item used by Valerio and Heaton (2014) was used in the post-test of this research study to assess one's likelihood of screening for OSA. Figure 2.3 compares the pre-test/post-test from the current study and the pre-test/post-test from the study by Valerio and Heaton (2014).

Figure 2.3 OSA Educational Module Pre-test/Post-test Content

OSA Educational Module Pre-test/Post-test		
	Current Study	**Valerio & Heaton (2014)**
Topics of multiple choice questions (not based on case study)	**9 questions** - OSA severity (1), prevalence (1), associated adverse health conditions (1), risk factors (1), Mallampati Classification (1), diagnosis (1), treatment options (1), and accuracy of screening questionnaires (2)	**1 question** – why OSA should be considered in evaluation of adult patients
Topics of case study multiple choice questions	**2 case studies & 8 total questions** - - Risk factors (2), associated adverse health conditions (2), Mallampati Classification (2), screening questionnaires (2)	**3 case studies & 14 total questions** Risk factors (2), associated adverse health conditions (1), Mallampati Classification (1), screening questionnaires (1) Health consequences (1), reason to screen (2), symptoms (5), physical features consistent w/OSA (1)
Free response questions topics (post-test only)	**2 questions** - Perceived importance of OSA screening (1) and anticipated challenges in OSA screening (1)	**None**
Likert-Based question topic (post-test only)	**1 question** - Likeliness of screening patients for OSA	**1 question** - Likeliness of screening patients for OSA
Total questions	**20 questions**	**16 questions**

Figure 2.3. Pre-test/post-test content comparison of the current research study, and the study conducted by Valerio and Heaton (2014). The current research pre-test/post-test was adapted to increase applicability to DH students.

Additionally, a demographic questionnaire was completed with the pre-test, and a program evaluation was completed with the first post-test. A copy of the demographic

questionnaire is attached in Appendix G, and a copy of the program evaluation is attached in Appendix H. The demographic questionnaire was used to gather descriptive data about participants, and included questions regarding: age, gender, ethnicity, education, and family history of OSA. The program evaluation was used to gauge the participants' interpretation of the quality of the module and of the presenter using Likert-type items.

Equipment. To facilitate delivery of the educational module, Canvas© LMS was utilized. Additionally, a "select" subscription to SurveyMonkey© was purchased for the duration of the research, which included unlimited questions, 1,000 responses, and data export features. SurveyMonkey© was used to facilitate the pre-test, demographic questionnaire, post-test, and program evaluation. Microsoft PowerPoint was used to create a PowerPoint presentation, and the "record slide show" function was utilized to add narration to the presentation. The video demonstrations of screening questionnaires were included within the PowerPoint presentation. To increase accessibility, the narrated PowerPoint was converted into a video, and uploaded to YouTube. As the video demonstrations were part of the PowerPoint presentation, only one video was uploaded to YouTube. Microsoft Excel was used for data analysis.

Steps to implementation. Prior to EWU IRB approval, the educational module was reviewed by the thesis committee for this research, all MSDH faculty at EWU, and by an OSA content expert. An official letter explaining the purpose of the study and requesting permission to conduct the study was sent to the EWU DH program director. A copy of this letter is attached in Appendix I. After obtaining EWU IRB approval, a pilot test of the educational module was conducted with graduate students who entered the

EWU MSDH program in the fall of 2015. This cohort of MSDH students was selected to pilot test the educational module due to their DH background and successful completion of a research methodology course. Pilot study participants were emailed a cover letter and consent form explaining the research. The email contained SurveyMonkey© and YouTube links and instructions for completing the pilot study. The cover letter and consent form for pilot study participants is attached in Appendix L. A copy of the pilot study instructions is attached in Appendix P. Pilot study participants were given one week to complete the educational module and provide feedback via an anonymous SurveyMonkey© link. Of the five MSDH students invited to participate, two completed the pilot study within the suggested time frame, and one completed the pilot study ten days following the deadline (n=3). As one participant completed the pilot study after the deadline, utilizing this participant's suggestion to reduce literature review content within the educational module was not feasible. Another pilot study participant suggested breaking the educational module into shorter clips. After consulting with the thesis committee for this research, this suggestion was not implemented as the committee decided one video was more appropriate for this type of educational module. As there were only three pilot study participants, the only feedback utilized was to improve the sound quality of the OSA educational video. Prior to research implementation, the sound quality was effectively improved to where it was no longer a research limitation.

The proposed research was conducted during the 2017 spring academic semester. During the DNHY 341S *Management of the Medically Compromised* course meeting on Thursday, January 26th, the course instructor introduced the research study using the *Research Introduction Script* (Appendix M), and provided students with random

identification numbers. The Canvas© module opened for students directly following class on this day. The opened module contained active SurveyMonkey© links for the pre-test and demographic questionnaire and remained active until Sunday, January 29th. Upon opening the SurveyMonkey link for the pre-test, students were asked if their anonymous data from the pre-test, post-test, demographic questionnaire, program evaluation, and second post-test could be used for research and publication purposes. For each SurveyMonkey© assessment, students were asked to provide their assigned identification number. On Monday, January 30th, the YouTube link for the OSA educational video became active and remained active until Sunday, February 5th. At this point, the YouTube link became inactive. The links for the post-test and program evaluation became active on Monday, February 6th and remained active until Monday, February 13th. SurveyMonkey© data from the post-test was forwarded to the course instructor, who assigned student grades. During the DNHY 341S course meeting on Thursday, February 23rd, the course instructor reminded students to complete the post-test a second time. The link for the second post-test was activated directly following this class, and remained active until Monday, February 27th. Only the first post-test influenced student grades. The proposed implementation schedule ensured the pre-test was completed prior to viewing of the OSA educational video, and the OSA educational video was unavailable while the post-test was active. A copy of the implementation schedule for the educational module is attached in Appendix N.

After the entire research protocol was completed, the anonymous SurveyMonkey© data was imported into Microsoft Excel software for data analysis. Data was stored on a password protected computer accessible only by the PI. This method of data collection

was selected due to the apparent suitability in evaluating the effectiveness of an online module. By utilizing an identical pre-test/post-test, the change in knowledge of participants could be assessed. Following EWU's requirement to maintain research records for a minimum of three years, all data and personal information will be safely kept in a password protected computer until destroyed three years after completion of this research.

Summary

A mixed-method, one-group, pre-test/post-test method was used to determine if an online educational intervention significantly increased the knowledge of information relevant to OSA screening in DH students. The sample population was characterized using results from a demographic questionnaire. A combination of quantitative and qualitative data analysis was used to interpret data results, and statistical significance was recognized at $p < .05$.

Results

Description of Sample

A convenience sample of first year DH students (*N*=40) enrolled in the DNHY 341S *Management of Medically Compromised* course at EWU participated in the study. Of the 40 students, 38 students consented to their data being used for research and publications purposes; one student skipped the consent question on the pre-test assessment and one student did not take the pre-test. Of the 38 students who consented to the research study, three were excluded due to the lack of first post-tests with corresponding identification numbers. As two first post-tests were completed with no identification number provided, it can be assumed that of these three excluded participants, two completed a post-test but did not provide an identification number, and one did not complete a first post-test. Additionally, two participants were excluded due to the same identification number being used. As both of these participants used the same identification number for the pre-test, first post-test, and second post-test, it is unlikely that the identification numbers were entered by participants incorrectly. As the researcher does not have access to the information that corresponds identification numbers to participants, it can only be speculated that the two students were mistakenly assigned the same identification number. A total of 33 participants (*n*=33) were included in the research study, which exceeds the 32 participants needed to have 80% power with a 95% confidence level. Of the 33 participants with matching pre-test and first post-test

assessments, 32 completed the demographic questionnaire (*n*=32), 27 completed the program evaluation (*n*=27), and 28 completed the second post-test (*n*=28). Summary of participant inclusion and exclusion is provided in Figure 3.1. Of the participants who completed the demographic questionnaire (*n*=32), the majority were white/Caucasian females, aged 18-22 years old, with the highest degree an associate, and no immediate family history of OSA. Summary of demographic data is provided in Table 3.1.

Figure 3.1 Summary of Participant Inclusion and Exclusion

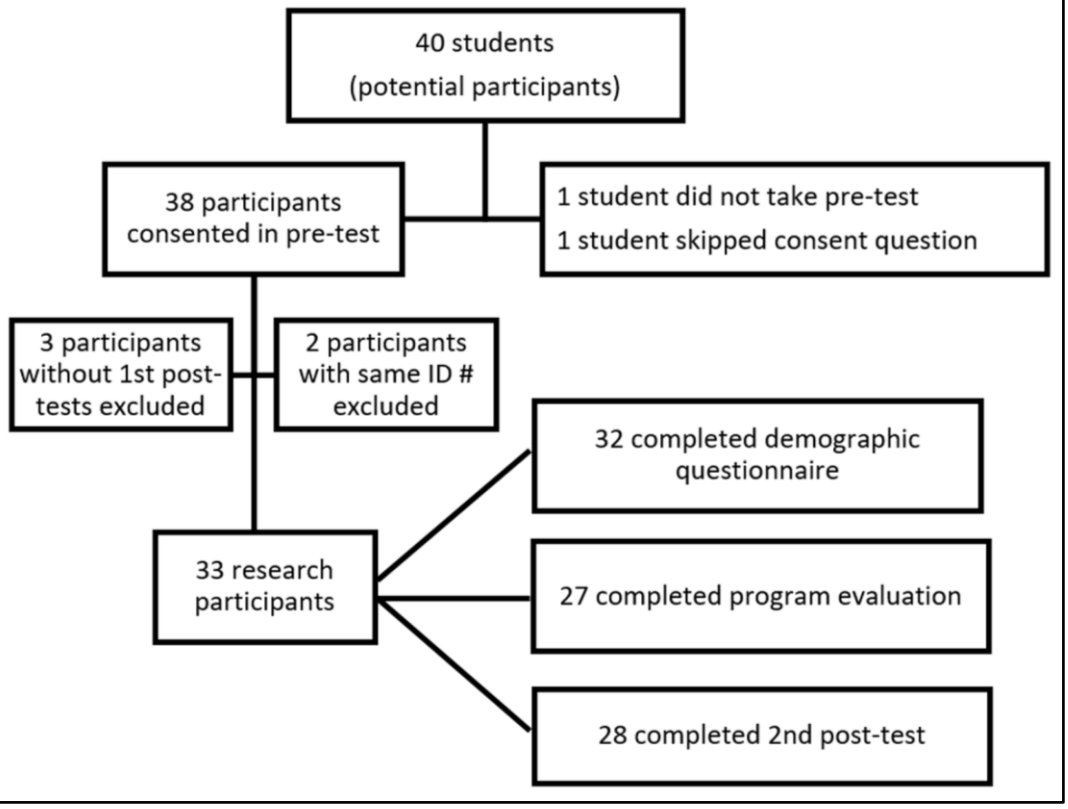

Table 3.1

Demographic Characteristics of Research Participants

Demographic characteristic	*n*	%
Age		
18-22 years old	16	50%
23-27 years old	7	21.88%
28-32 years old	5	15.63%
33+ years old	4	12.51%
Gender		
Female	31	96.88%
Male	1	3.13%
Ethnicity		
White/Caucasian	24	75%
Hispanic/Latino	1	3.13%
African American	1	3.13%
American Indian/Alaskan Native	0	0%
Asian	1	3.13%
Native Hawaiian/Pacific Islander	0	0%
More than one ethnicity identified	5	15.63%
Highest degree		
High school diploma or equivalent	12	37.50%
Associate degree	16	50%
Bachelor degree	4	12.50%
Master degree	0	0%
Doctorate degree	0	0%
Other	0	0%
Immediate family w/OSA		
Yes	7	21.88%
No	25	78.13%

Statistical Analysis

This study aimed to determine if an online educational intervention could significantly increase the knowledge of information relevant to OSA screening in DH students. To assess this research question, differences between mean pre-test and first post-test scores were evaluated to assess the change in OSA knowledge. The mean pre-test score was 8.30 (48.84%, SD = 2.88) and the mean first post-test score was 13.61 (80.04%, SD = 1.77). A paired *t*-test was conducted to determine if a statistically

significant difference occurred. The results of this analysis showed a statistically significant increase in mean first post-test scores, compared to pre-test scores ($p < .001$, $t(33) = 9.836$). Differences between mean scores for the first and second post-test were evaluated to assess knowledge retention using a paired *t*-test. The mean second post-test score was 12.74 (74.79%, SD = 2.51), in comparison to the first post-test mean score of 13.61 (80.04%, SD = 1.77). The results of this analysis did show a statistically significant decrease in the second post-test mean score, compared to the first pre-test mean score ($p < .05$, $t(28) = 2.214$). Differences between mean scores for the pre-test and second post-test were also evaluated using a paired *t*-test to determine if increased mean scores from the pre-test to the second post-test were statistically significant. The results of this analysis showed a statistically significant increase in the second post-test mean score, compared to the pre-test mean score ($p < .001$, $t(28) = 5.653$).

Additionally, paired *t*-tests were used to assess change in responses from the pre-test to the first post-test for each individual question. A similar statistical analysis was conducted in the study of NPs by Valerio and Heaton (2014). A statistically significant increase in correct responses per question was found pre-test versus first post-test in ten of 17 questions ($p \leq .05$), with three additional questions approaching significance ($p = .08$). In one question, the number of correct responses was lower in the first post-test than in the pre-test. Two of the questions that did not have a statistically significant increase in correct responses also experienced a high percentage of correct responses on the pre-test. One of these questions asked participants to identify obesity as a prominent risk factor of OSA. On the pre-test, 94% of participants (n=31) identified obesity as the correct response. On the other question, 73% of participants (n=24) identified

polysomnography (PSG) as the "gold standard" diagnostic test for OSA on the pre-test. Conversely, another question with non-significant changes in correct responses asked participants to identify health conditions commonly associated with OSA. Only 30% of participants (*n*=10) answered this correctly on the pre-test, and 36% (*n*=12) on the first post-test. Lastly, there was a decrease in correct responses on a question asking participants to identify Mallampati classification. Results from the pre-test to first post-test for each individual question is provided in Table 3.2.

To determine if an association existed between pre-test scores and immediate family history of OSA, a two-sample *t*-test was conducted. Twenty-two percent (*n*=7) participants who completed the demographic questionnaire indicated a member of their immediate family had been diagnosed with OSA. The mean pre-test score for participants who indicated a family history of OSA was 9.29 (54.62%), compared to a mean pre-test score of 8.00 (47.06%) for participants who did not indicate family history of OSA. The results this analysis concluded there was no detectable difference in mean pre-test scores between participants with family history of OSA and participants without (p = 0.45). This conclusion is ambiguous due to the limited power of the test.

To gauge the participants' interpretation of the quality of the educational module, mean descriptive statistics were used to analyze results from the program evaluation. Eighty-two percent of participants (*n*=27) completed the program evaluation. A summary of program evaluation results is provided in Figure 3.1. Most notably, 96% of participants (*n*=26) who completed the program evaluation indicated they *agree* or *strongly agree* the program content was appropriate to their level of understanding and provided participants with the information they need to screen patients for OSA.

Additionally, 81% (*n*=22) indicated they *agree* or *strongly agree* the program material was presented in a way that helped participants learn, but only 37% (*n*=10) *agreed* or *strongly agreed* online learning was as effective as face-to-face instruction.

Table 3.2

Individual Question Pre-test to First Post-test Results

Question	Pre-test correct response	Post-test correct response	*p*-value
Q1 – Severity (based on AHI)	15	29	< .001
Q2 – Prevalence	20	32	< .001
Q3 – Associated adverse health conditions	21	30	.005
Q4 – Risk factors	12	31	< .001
Q5 – Mallampati classification	9	24	< .001
Q6 – Diagnostic tests	24	29	.169
Q7 – Treatment options	17	26	.027
Q8 – Most accurate screening questionnaire	19	25	.083
Q9 – Least accurate screening questionnaire	11	29	< .001
Q10 – Case study: risk factors	31	33	.160
Q11 – Case study: adverse health conditions	10	12	.625
Q12 – Case study: Mallampati classification	12	28	< .001
Q13 – Case study: OSA risk (Berlin Questionnaire)	11	28	< .001
Q14 – Case study: risk factors	17	23	.083
Q15 – Case study: adverse health conditions	18	24	.083
Q16 – Case study: Mallampati classification	21	19	.625
Q17 – Case study: OSA risk (STOP-BANG Questionnaire)	6	27	< .001

P-values based on two-tailed paired *t*-tests. Statistical significance recognized at $p < .05$.

Thematic qualitative analysis was used to identify prominent themes from open-ended questions added to the first post-test. For each open-ended question, primary themes were identified and coded within participant responses. Next, secondary themes within each primary theme were identified and coded. The first open-ended question asked participants following completion of the OSA educational module if they believe screening for OSA is important. All participants (*n*=33) indicated they believed screening for OSA was important. Prominent themes identified included: DHs being in

a position to screen for OSA, the influence OSA has on oral and systemic health, patients being unaware of OSA risk, and the potential for OSA treatment to improve quality of life. The second open-ended question asked participants what challenges they anticipate in screening patients for OSA. Prominent themes identified included: limited time, patients being unaware of sleep habits, accuracy of self-reported data, lack of credibility of dental hygienists to complete OSA screening, and difficulty determining which OSA screening method to utilize. Lastly, a Likert-type question was added to the first post-test that asked participants how likely they are to evaluate their adult patients for OSA following the educational module. Seventy-six percent of participants (*n*=25) indicated they were *likely* or *very likely* to evaluate adult patients for OSA, and 24% (*n*=8) indicated they were *unsure*.

Comparing the pre-test/post-test of the current study and the study by Valerio and Heaton (2014), six questions had similar content. Both studies found a significant increase in knowledge regarding the prevalence of OSA and the Mallampati classification. Neither study found an increase in knowledge regarding obesity being a risk factor for OSA, or hypertension being an associated health condition. Conversely, the current study demonstrated a statistically significant increase in knowledge regarding hypertension and type II diabetes being conditions associated with OSA, while Valerio & Heaton (2014) did not. Furthermore, Valerio & Heaton (2014) found a statistically significant increase in knowledge regarding menopause as a risk factor, while the current study did not. Lastly, both studies asked participants how likely they were to evaluate adult patients for OSA following the educational program. In the current study, 76% of participants (n=25) indicated they were likely or very likely to evaluate for OSA,

compared to 100% of participants (n=38) in the Valerio and Heaton (2014) study.

Questions with similar content are compared in Table 3.3.

Table 3.3

Question Comparisons – Current Study vs. Valerio & Heaton (2014)

Question Topics	*p*-value
Current Study (Q2): prevalence (men vs. women)	< .001
Valerio & Heaton (Q1): prevalence (percentage of population)	< .001
Current Study (Q3): associated conditions (hypertension, type II diabetes & coronary heart disease)	.005
Valerio & Heaton (Q15): high-risk conditions (hypertension & type II diabetes)	.210
Current Study (Q10): risk factors (obesity)	.160
Valerio & Heaton (Q2): signs & symptoms (obesity)	.324
Current Study (Q12): Mallampati classification (class IV)	< .001
Valerio &Heaton (Q13): Mallampati classification (class IV)	.023
Current Study (Q14): risk factors (age & menopause)	.083
Valerio & Heaton (Q7): risk factors (menopause)	.001
Current Study (Q15): adverse health conditions (hypertension)	.083
Valerio & Heaton (Q3): health consequence (hypertension)	.711
Post-test question: after participating in this educational program, how likely are you to evaluate your adult patients for OSA? (*likely* or *very likely*)	
Current study: 76%	
Valerio & Heaton: 100%	

Figure 3.2 Program Evaluation

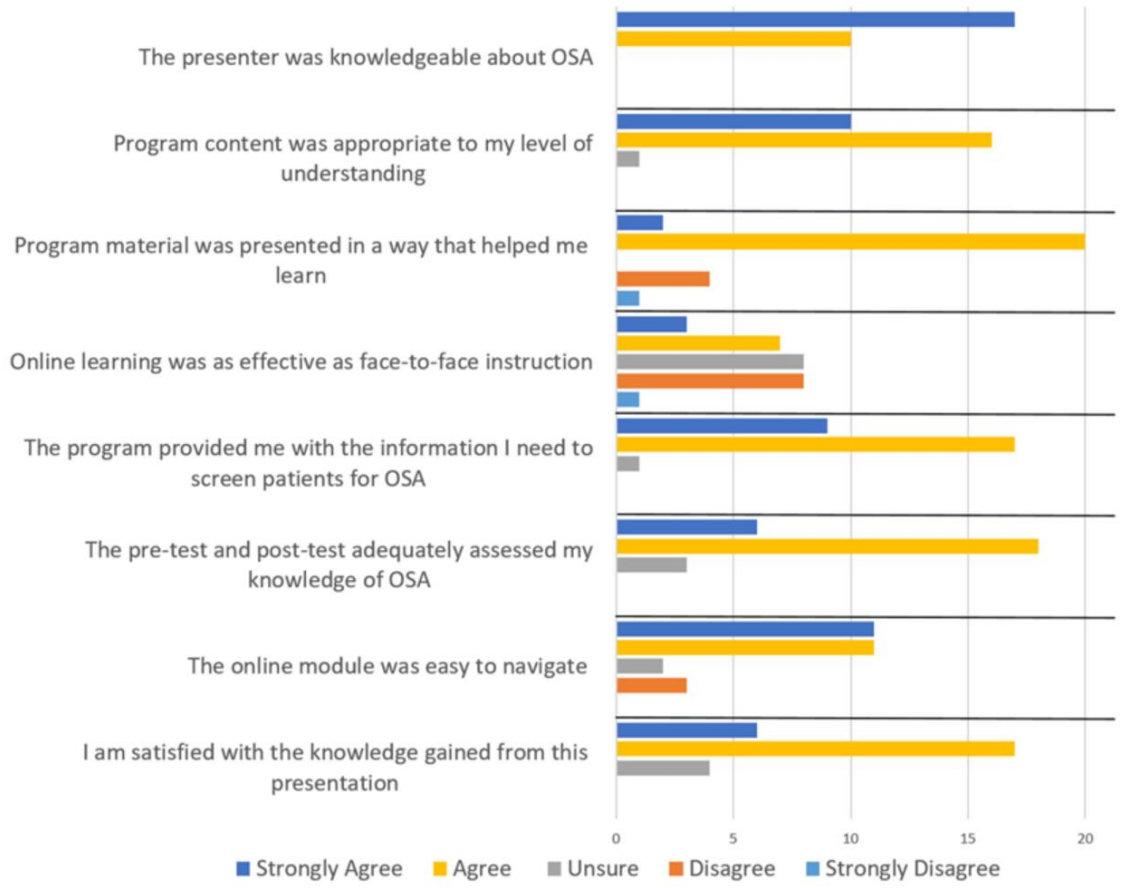

Figure 3.1. Summary of program evaluation data. Program evaluation was completed by 27 of the 33 participants.

Discussion

Summary of Major Findings

The results of this study provided statistically significant data that supports an online educational intervention can significantly increase the knowledge of information relevant to OSA screening in DH students. Results demonstrated a significant increase between mean pre-test and first post-test scores ($p < .001$). A statistically significant increase in correct responses per question pre-test versus first post-test was identified in ten of 17 questions ($p \leq .05$), with three additional questions approaching significance ($p = .08$). A significant change in mean scores was identified between the first and second post-scores ($p < .05$). No detectable difference in pre-test scores was found between participants with a family history of OSA (n=7) and participants without (n=25). A majority of participants (n=26) *agreed* or *strongly agreed* that the program content was appropriate to their level of learning and provided participants with the information they need to screen patients for OSA. Conversely, just over one-third of participants (n=10) *agreed* or *strongly agreed* online learning was as effective as face-to-face instruction. Lastly, following completion of the online educational module, all participants (n=33) indicated they believed OSA screening was important, and 76% (n=25) indicated they are likely or very likely to screen their adult patients for OSA.

Discussion

The results of this study suggest an online educational module has the potential to provide an effective means of increasing DH student knowledge of OSA. Data from the pre-test and first and second post-test suggest a significant change in OSA knowledge following the completion of the OSA educational module. Responses to the program evaluation suggest overall quality of the educational module. Lastly, themes from thematic analysis of open-ended questions provide insight into participants' perception of OSA screening following completion of the educational module.

Individual questions. Two questions that did not have a statistically significant increase in correct response also experienced a high percentage of correct responses on the pre-test, which suggests prior knowledge of the information. The high percentage of correct pre-test responses to these questions left minimal margin for statistically significant improvement. Non-significant knowledge changes in another question may be contributed to the wording of the question, which allowed participants to select "all of the above" or "both A & B," with the inclusion of periodontal disease being the difference between the two response options. As a majority of participants selected "both A & B," thus excluding periodontal disease, it may not have been clear within the case study that the individual had active periodontal disease, or that periodontal disease is considered a health condition *commonly* associated with OSA. Lastly, the decrease in correct responses regarding Mallampati classification may be due to the slight differences in Mallampati classification, with the difference between two categories being the ability to see a *portion of the uvula* versus the *possible the base of the uvula*. This content may have been unclear to participants, resulting in a decrease in correct responses. Despite

select questions not demonstrating statistically significant changes in correct responses, overall results demonstrate a statistically significant ($p < .001$) change in mean pre-test to first post-test scores.

Comparison to OSA educational intervention for NPs. Results from the pre-test and first post-test support the research of Valerio and Heaton (2014), who investigated the effects of an online OSA educational module for nurse practitioners (NPs). Valerio and Heaton (2014) also found a statistically significant increase in post-test scores, compared to pre-test scores ($p < .001$). Their study found a statistically significant increase in correct responses per question pre-test versus post-test in seven of 15 questions, and experienced a decrease in scores from pre-test to post-test in two questions. Of the questions with similar content to that of Valerio and Heaton (2014), variation in question wording and educational module content may have attributed to differences in knowledge gain.

Furthermore, the lower percentage of DH students compared to NPs who indicated they were *likely* or *very likely* to evaluate for OSA following an online educational module might be influenced by professional training differences between DHs and NPs, knowledge differences between students and practicing health professionals, or variations in the educational module. Nurse practitioners in the Valerio & Heaton (2014) study may have exhibited more favorable attitudes towards OSA screening as these participants were actively practicing health professionals. Conversely, participants in the current study were first year DH students in the process of obtaining foundational knowledge of DH practice. As the NPs had experience in clinical practice, they may have been more prepared to acknowledge the value of OSA screening for

existing patients. First year DH students have had less opportunity to establish such relationships. The differences between these participant groups may suggest a need for DH educators to emphasize the role of DHs in screening for systemic conditions and for DH to recognize their role in promoting systemic health.

Similar results between the current study and Valerio and Heaton's (2014) support the effectiveness of an online module in providing OSA education for healthcare professionals. With the prevalence of OSA estimated at 26% (Peppard et al., 2013), and the percentage of undiagnosed individuals as high as 80% in some studies (Lee et al., 2008), available avenues of OSA education warrants consideration. The effectiveness of an online educational module is significant as it provides an alternative to the traditional lecture format. As Minichbauer (2014) found only 32% of a sample of DH programs include OSA education in the curriculum, and Valerio and Heaton (2014) reported only 1.97 hours of sleep education in their study sample of NPs, results support an effective alternative method of OSA is significant to healthcare education.

Knowledge retention. To test knowledge retention, participants were asked to complete an identical post-test two weeks following completion of the first post-test assessment. Of the participants who completed the second post-test (n=28) a statistically significant decrease from first post-test to second post-test was detected ($p < .05$). It can be speculated that some knowledge loss is anticipated, as participants completed the first post-test directly following having access to the OSA educational video, and completed the second post-test two weeks following completion of the educational module. These results are supported by a 2006 Canadian study that investigated knowledge loss of medical students from first year basic science courses (D'Eon, 2006). This study

recruited second year medical students to retake test questions from three first year basic science courses (immunology, physiology, and neuroanatomy) and compared the results to their original scores from 10 to 11 months prior. This study found a statistically significant main effect of knowledge loss ($p < .001$). Although not researched, the authors of this study discussed the value of knowledge reinforcement in the curriculum to improve knowledge retention. This study demonstrates that some degree of knowledge loss is to be anticipated in healthcare education. It is important to note that despite a statistically significant decrease in mean scores from the first to the second post-test ($p < .05$) in the current study, there was still a statistically significant increase in mean scores from the pre-test to the second post-test ($p < .001$).

Family history of OSA. Within the demographic questionnaire, participants were asked if they had an immediate family history of OSA. Twenty-two percent of participants (n=7) who completed the demographic questionnaire responded positivity to this question. This is comparable to data from a 2013 epidemiology study that estimated 26% of individuals aged 30-70 years old between 2007 and 2010 had some degree of OSA (Peppard et al., 2013). Conversely, in the study by Valerio and Heaton (2014), 37.8% (n=14) of participants reported that a family member had been diagnosed with OSA. In an effort to investigate if immediate family history of OSA provided participants with significant prior OSA knowledge, mean pre-test scores of participants with family history of OSA (n=7) was compared to scores of participants without family history of OSA (n=25). Variations in these reports may have been influenced by the high percentage of OSA that is undiagnosed, or participants not being aware of family members OSA condition. Although the mean pre-test score for participants who

indicated a family history of OSA was slightly higher compared to the mean pre-test score for individuals without, there was no statistically significant difference detected. This finding suggests that a family history of OSA does not significantly increase knowledge of the condition, and thus does not prepare participants to recognize and screen for OSA. Based on this, individuals with a family history of OSA should be viewed by educators as needing the same level of education needed identity patients at high risk for OSA.

Program evaluation. The program evaluation provided a means by which to evaluate the participants' interpretation of the quality of the educational module. The statistically significant increase in mean first post-test scores compared to pre-test scores is supported by participants who indicated that they *agree* or *strongly agree* that the program content was appropriate to their level of understanding and indicated that they *agree* or *strongly agree* that program material was presented in a way that helped them learn. Despite this, the majority of participants did not *agree* or *strongly agree* that online learning was as effective as face-to-face instruction. This is contradictory to a 2013 meta-analysis that found the mean effect sizes between purely online versus face-to-face instruction are not significantly different (Means et al., 2013). Furthermore, the results of this meta-analysis indicated a blended online and face-to-face instructional style, similar to the *flipped classroom* pedagogy utilized in DNHY 341S, positively influences student learning outcomes (Means et al., 2013). The flipped classroom pedagogy utilized in DNHY 341S can be considered a blended instructional method as some aspects of pre-instructional learning are completed via Canvas followed by course meetings in a physical location. Participants being accustomed to a blended online and

face-to-face instructional style may have negatively impacted the participants' interpretation of the purely online delivery style of the OSA educational module. The negative perception of purely online education from participants in the current study and results from the meta-analysis by Means et al. (2013) suggest purely online education may not be as effective as a blended online and face-to-face instructional style. Additionally, a 2016 research study investigating the millennial DH student and faculty learning preferences found that 64.4% of respondents (*n*=425) preferred lecture over other forms of instruction. This suggests that, despite evidence of improved student learning outcomes with blended online and face-to-face instruction, DH students prefer the face-to-face lecture style. Based on these results, educators will need to determine in which capacity to utilize online OSA education for students.

Furthermore, low self-efficacy with online learning may negatively influence student perception of ability to complete OSA screening in clinical practice. In a 2014 article, Vilkas and McCabe discussed strategies to promote student self-efficacy in the online classroom. The authors of this article reference research by Albert Bandura (1997) who suggests that there are four factors that affect an individual's self-efficacy: experience of mastery, vicarious experience, social persuasion, and physiological factors (Vilkas & McCabe, 2014). The online OSA education module does not address these four factors, particularly the experience of mastery. The structure of the educational module did not facilitate the opportunity for participants to apply the knowledge on an actual patient, which would establish a sense of mastery of the skill. This lack of hands on experience may have negatively influenced student perception of the purely online nature of the OSA educational intervention.

Thematic Analysis. The open-ended questions added to the first post-test provided valuable information regarding the participants' perceptions of OSA screening following the educational module. Thematic data retrieved from answers to these questions provided insight into participants' perceptions of OSA screening following the educational module.

Beliefs on OSA screening. All participants (*n*=33) believed OSA screening was important for reasons including: DHs being in a position to screen for OSA, the influence OSA has on oral and systemic health, patients being unaware of OSA risk, and the potential for OSA treatment to improve quality of life. The themes identified indicate the educational module was effective in increasing participants' knowledge of risk factors, oral manifestations, and consequences of untreated OSA, which were prominent themes of the OSA educational module. The themes are comparable to those identified in the literature review, *Obstructive Sleep Apnea and the Role of the Dental Hygienist,* by Kornegay and Brame (2015). This literature review discusses "dental hygienists are at a pivotal position to discuss risks, characteristics, medical referrals and treatment options for OSA, as well as detect if an individual has OSA" (Kornegay & Brame, 2015, p. 286). The authors of this literature review discuss the impact OSA has on systemic health, as well as the association between OSA and periodontal disease. Kornegay and Brame (2015) go on to discuss how the interprofessional collaboration of DHs screening and referring for suspected OSA will provide patients with the best quality of care. These themes are further supported by the 76% of participants (*n*=25) who indicated they are *likely* or *very likely* to screen their adults patients for OSA.

Challenges in OSA screening. Prominent themes identified by participants regarding challenges they anticipate in screening patients for OSA included: limited time, patients being unaware of sleep habits, accuracy of self-reported data, lack of credibility of DHs to complete OSA screening, and difficulty determining which OSA screening method to utilize. Although these themes largely represent the perception of this limited sample population, similar themes have been suggested in research literature.

Limited time. Lack of time to complete an OSA screening was one of the most prominent themes identified. Procedures completed within a dental hygiene appointment and the typical amount of time allocated was discussed in an article by Forbes (2015). In this article, the author first described the typical duties of a dental hygienist in 1972 that included, greeting patients, taking radiographs, performing an intra-oral exam, localized periodontal probing, debridement (cleaning), oral homecare instruction, chart notes, and sterilization (Forbes, 2015). Based on current guidelines from the American Academy of Periodontology (AAP) and the American Dental Hygienists' Association (ADHA), the author outlines the minimum list of procedures expected of DHs in 2015. In addition the duties expected of DHs in 1972, DHs are now expected to: review health histories, document medications, and discuss medical contraindications with patients; take and record vital signs; review and discuss risk factors to any medical/systemic conditions and correlate to potential periodontal conditions; complete a head-and-neck exam, intra-oral exam, and oral cancer screening; take IO photographs; complete periodontal probing of all teeth, determine AAP disease classification; develop dental hygiene treatment plan; and start or complete appropriate dental hygiene therapy (Forbes, 2015, p. 26-28). Notably, discussing risk factors to any medical/systemic conditions, such as OSA, is

considered an expectation of the DH. The difference in these lists of expectations illustrates why students may anticipate lack of time being a major challenge in screening for OSA. To combat this anticipated challenge, it is important to provide students with a time efficient questionnaire, such as the STOP-BANG or Berlin questionnaire, and for educators to reinforce the importance of OSA screening for overall patient health. Furthermore, the development of time management skills, including recognizing and advocating for the time needed to providing comprehensive patient care.

Accuracy of self-reported data. As a significant portion of the Berlin Questionnaire (BQ), STOP-BANG Questionnaire, and the Epworth Sleepiness Scale (ESS) rely on self-reported data, the accuracy of self-reported data was a prominent anticipated challenge of participants. Although research has not been conducted on the accuracy of self-reported data for these specific questionnaires, there is research to support general inaccuracy of self-reported data. For example, in 2014 Poston, Jitnarin, Haddock, Jahnke, and Day investigated the accuracy of self-reported weight, height, and BMI in US firefighters. For this study, self-reported and measured weight, height, and BMI were assessed in a national sample of 1001 male firefighters in the United States. From this data, differences between self-reported and measured data was analyzed. The researchers found the mean difference and standard deviation between self-reported weight, height, and BMI were 1.3 ± 2.0 kg, 0.94 ± 1.9 cm, and $0.09 \pm 0.9 kg/m^2$, respectively (Poston, Jitnarin, Haddock, Jahnke, & Day, 2014). Additionally, the National Sleep Foundation website states snorers are generally unaware of their snoring, and must rely on the observations of their bed-partners (National Sleep Foundation, 2017). This further justifies the anticipated reported challenges of inaccurate self-reported data. However, it

can be assumed the potential benefit of OSA screening, even with false negative results due to inaccurate self-reported data, far outweighs the negatives. It is important to recognize OSA screening is not a definitive diagnosis, and health professionals who screen for OSA are not determining if an individual has OSA, but identifying risk and referring if appropriate.

*Credibility of DHs to complete OSA screening***.** Another prominent challenge identified by participants was a perceived lack of credibility of DHs to screen for OSA. Although there is no current research that demonstrates the competence of DHs in screening for OSA, there have been several published articles to suggest that DHs are capable of, and in a prime position to screen for OSA. The literature review by Kornegay and Brame (2015) suggested that DHs are at a pivotal position to contribute interprofessionally to the screening of OSA. The thesis research by Minichbauer (2014) that studied sleep medicine content in DH education suggested DHs are "on the frontline regarding prevention and counseling…If sleep questionnaires were included in medical histories, the knowledgeable DH would also assess the patients' risk level and perform further inquiry or referral if needed" (Minichbauer, 2014, p. 23). A peer-reviewed CE course by Heinrich (2013) stated dentists and DHs can easily screen patients for OSA during regular recall examinations. The author goes on to discuss that OSA referrals are an excellent way to merge the efforts of physicians and oral health professionals (Heinrich, 2013). Lastly, a peer-reviewed CE course by Fabbie (2015) discussed the role of myofunctional analysis in dental assessments and oral health. This author stated "dental hygienists as oral health educators have a unique opportunity to assess the deviations from normal that may alert the dentist that a sleep referral is indicated"

(Fabbie, 2015, 83). Furthermore, Minichbauer (2014) found OSA education was already incorporated into 32% of participating DH programs. As more DH programs incorporate OSA education into the curriculum, the more credibility for DHs to screen for this condition will increase. This education, as well as the support of previous authors, suggest DHs are credible sources for OSA screening and incorporation of OSA screening into routine dental appointments has potential to positively influence the overall health of patients.

Difficulty selecting OSA screening method. The systematic review by Abrishami et al. (2010) found the Berlin Questionnaire (BQ) to have the highest specificity for all degrees of OSA, and the meta-analysis by Ramachandran and Josephs (2009) found the BQ to be the most accurate questionnaire for predicting OSA diagnosis. Abrishami et al. (2010) found the STOP-BANG Questionnaire to have the highest sensitivity for moderate to severe OSA, and Ramachandran and Josephs (2009) found the STOP-BANG Questionnaire to be an excellent method for predicting severe OSA. This research may lead to confusion in regards to determining which of these questionnaires to use, including the difference between specificity and specificity. Additionally, Kandray et al. (2013) reported that an increased Mallampati classification correlates to an increased severity of diagnosed OSA, but it is unclear in the research how this assessment compares to screening questionnaires. These themes, including difficulty selecting an OSA screening questionnaire, represent participants' perception of anticipated challenges following completion of the educational module. To address this difficulty in selecting an OSA screening questionnaire, students should be introduced to and given the opportunity to practice with each OSA screening method. Furthermore, students should

be provided relevant research, such as that in the OSA educational module for the current study. Then, if OSA screening is needed they may choose the method most appropriate for individual patients.

Implication of discussion findings. The results of this study demonstrate an online educational intervention can significantly increase the knowledge of information relevant to OSA screening in DH students. In a 2014 thesis research study, it was found only 32% (*n*=36) of participating DH programs reported education of OSA in the curriculum (Minichbauer, 2014). More specifically, only 5% of participating DH programs (*n*=5) indicated teaching the use of OSA screening questionnaires (Minichbauer, 2014). Additionally, the *ADHA Dental Hygiene Conceptual Research Model* supports "discovery of new tools for diagnosis of conditions and diseases and new methods of risk assessment prior to development of disease" (ADHA Council on Research, 2016, p. 9). Based on ADHA's position regarding new methods of risk assessment, as well as limited OSA education anticipated in current DH curriculums, results of the current study suggest an online OSA educational module could be a practical implication of OSA education for the DH student.

Limitations

This study was limited by the sample size, missing data, and research methods. Due to the nature of convenience sampling, results of this study cannot be generalized as it is unknown if this sample is representative of the entire DH student population (Bryman, 2012). Specifically, it is unknown if the sample is representative of DH students in other stages of their education, as only first year DH students from EWU were invited to participate. Although the number of participants who completed the pre-test

and first post-test (*n*=33) exceeded the number of participants needed for the results to have 80% with a 95% confidence level, the lower response rates on the demographic questionnaire (*n*=32), program evaluation (*n*=27), and second post-test (*n*=28) is a study limitation. Limited time of the sample source may also be considered a limitation that negatively influenced response rates. Lastly, limited participation and feedback from the pilot study limited the degree to which the educational module could be improved prior to research implementation.

Recommendations/Suggestions for Future Research

The current study investigated the use of an online OSA educational intervention for DH students, although studies using a larger sample of DH students would improve the generalizability of results. Continued investigation of the use of an online OSA educational intervention with other healthcare professionals is warranted. Future variations of the online OSA educational module used for the current research study should consider combining questionnaires in an effort to increase complete participation, and changing questionnaire settings to require responses, so questions are less easily skipped by participants. Investigation of an online educational module for nurses, physician assistants, dentists, and other healthcare professionals would increase the validity and generalizability of the educational strategy. As the primary role of OSA screening is referral, research regarding interprofessional education (IPE) of OSA among healthcare professions may illustrate a need for healthcare professionals competent in working interprofessionally.

Additional areas to explore include evaluating the length and content of the educational intervention. Investigation into the use of online active learning strategies,

such as interactive case studies, may demonstrate potential avenues to improve participant knowledge gain and retention. It may also be beneficial to investigate the value of requiring application of OSA knowledge in the DH curriculum, such as a clinical requirement to screen clinical patients for OSA. The open-ended question regarding anticipated challenges in OSA screening provided valuable insight into how future educational modules can better prepare healthcare professionals to screen for OSA. Specifically, content on time management, ways to promote accuracy of self-reported data, and strategies to select appropriate OSA screening methods could be added to future versions of the educational module. Further research with variations of an online OSA educational module may better illustrate the content and learning strategies that will best prepare healthcare professionals to screen for OSA.

Regarding delivery of the online education module, it would be beneficial to investigate alternative methods of content and assessment delivery. Further research on an online educational intervention using exclusively Canvas© LMS for content and assessment delivery would be beneficial in exploring possibilities for increased participation. In such a study, the researcher would require access to the Canvas© course, thus making data confidential versus anonymous. This study may also be conducted retrospectively to elicit full participation. Furthermore, such methodology may enable the researcher to monitor if participants in reality viewed the educational content, which would add value to research results.

Lastly, research is needed to determine if online OSA educational interventions significantly increase the number of individuals screened and referred for OSA diagnosis. As the goal of this research is to investigate strategies that have the potential to increase

OSA screening, it is important to consider if completion of an online OSA educational module actually results in increased screening, referral, and diagnosis. More specifically, research to determine the proportion of individuals who were screened and referred for OSA who were positively diagnosed and treated would provide valuable information on the competence of healthcare professionals to accurately screen for OSA.

Conclusions

The results of this study demonstrate an online educational intervention can significantly increase the knowledge of information relevant to OSA screening in DH students. Furthermore, participants retained a significant amount of the OSA knowledge gained. Qualitative data suggests DHs find OSA screening important and suggests the value of OSA education for healthcare professionals. In turn, this educational module has the potential to improve OSA screening and diagnosis resulting in improved health care outcomes.

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Appendix A

Berlin Questionnaire

Berlin Questionnaire©
Sleep Apnea

Height (m) _____ Weight (kg) _____ Age _____ Male / Female

Please choose the correct response to each question.

Category 1

1. Do you snore?
□ a. Yes
□ b. No
□ c. Don't know

If you answered 'yes':

2. You snoring is:
□ a. Slightly louder than breathing
□ b. As loud as talking
□ c. Louder than talking

3. How often do you snore?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

4. Has your snoring ever bothered other people?
□ a. Yes
□ b. No
□ c. Don't know

5. Has anyone noticed that you stop breathing during your sleep?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ □ e. Rarely or never

Category 2

6. How often do you feel tired or fatigued after your sleep?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

7. During your waking time, do you feel tired, fatigued or not up to par?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

8. Have you ever nodded off or fallen asleep while driving a vehicle?
□ a. Yes
□ b. No

If you answered 'yes':

9. How often does this occur?
□ a. Almost every day
□ b. 3-4 times per week
□ c. 1-2 times per week
□ d. 1-2 times per month
□ e. Rarely or never

Category 3

10. Do you have high blood pressure?
□ Yes
□ No
□ Don't know

Scoring Berlin Questionnaire

The questionnaire consists of 3 categories related to the risk of having sleep apnea. Patients can be classified into High Risk or Low Risk based on their responses to the individual items and their overall scores in the symptom categories.

Categories and Scoring:
Category 1: items 1, 2, 3, 4, and 5;
Item 1: if '**Yes**', assign **1 point**
Item 2: if '**c**' or '**d**' is the response, assign **1 point**
Item 3: if '**a**' or '**b**' is the response, assign **1 point**
Item 4: if '**a**' is the response, assign **1 point**
Item 5: if '**a**' or '**b**' is the response, assign **2 points**
Add points. *Category 1 is positive if the total score is 2 or more points.*

Category 2: items 6, 7, 8 (item 9 should be noted separately).
Item 6: if '**a**' or '**b**' is the response, assign **1 point**
Item 7: if '**a**' or '**b**' is the response, assign **1 point**
Item 8: if '**a**' is the response, assign **1 point**
Add points. *Category 2 is positive if the total score is 2 or more points.*

Category 3 is positive if the answer to item 10 is '**Yes**' or if the BMI of the patient is greater than 30kg/m_2.
(BMI is defined as weight (kg) divided by height (m) squared, i.e.., kg/m_2).

High Risk: if there are 2 or more categories where the score is positive.

Low Risk: if there is only 1 or no categories where the score is positive.

Additional Question: item 9 should be noted separately.

Obtained from

https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/media/Berlin%20Questionnaire.pdf

Appendix B

Epworth Sleepiness Scale

The Epworth Sleepiness Scale

The Epworth Sleepiness Scale is widely used in the field of sleep medicine as a subjective measure of a patient's sleepiness. The test is a list of eight situations in which you rate your tendency to become sleepy on a scale of 0, no chance of dozing, to 3, high chance of dozing. When you finish the test, add up the values of your responses. Your total score is based on a scale of 0 to 24. The scale estimates whether you are experiencing excessive sleepiness that possibly requires medical attention.

How Sleepy Are You?
How likely are you to doze off or fall asleep in the following situations? You should rate your chances of dozing off, not just feeling tired. Even if you have not done some of these things recently try to determine how they would have affected you. For each situation, decide whether or not you would have:

- No chance of dozing =0
- Slight chance of dozing =1
- Moderate chance of dozing =2
- High chance of dozing =3

Write down the number corresponding to your choice in the right hand column. Total your score below.

Situation	Chance of Dozing
Sitting and reading	•
Watching TV	•
Sitting inactive in a public place (e.g., a theater or a meeting)	•
As a passenger in a car for an hour without a break	•
Lying down to rest in the afternoon when circumstances permit	•
Sitting and talking to someone	•
Sitting quietly after a lunch without alcohol	•
In a car, while stopped for a few minutes in traffic	•

Total Score = _____

Analyze Your Score

Interpretation:

0-7: It is unlikely that you are abnormally sleepy.
8-9: You have an average amount of daytime sleepiness.
10-15: You may be excessively sleepy depending on the situation. You may want to consider seeking medical attention.
16-24: You are excessively sleepy and should consider seeking medical attention.

Reference: Johns MW. A new method for measuring daytime sleepiness: The Epworth Sleepiness Scale. *Sleep* 1991; 14(6):540-5.

Obtained from http://www.sleepapnea.org/assets/files/pdf/ESS%20PDF%201990-97.pdf

Appendix C

STOP-BANG Questionnaire

STOP BANG Questionnaire

Name_____ Age_____

Height_____inches Weight_____ lbs. BMI_____

Collar size of shirt: ☐ S ☐ M ☐ L ☐ XL, or _____inches

Neck circumference (measured by staff) _____cm

Snoring: Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?
☐ Yes ☐ No

Tired: Do you often feel tired, fatigued, or sleepy during the day?
☐ Yes ☐ No

Observed: Has anyone observed that you stop breathing during your sleep?
☐ Yes ☐ No

Blood **p**ressure: Do you have or are you being treated for high blood pressure?
☐ Yes ☐ No

BMI more than 35 kg/m^2?
☐ Yes ☐ No

Age over 50 years?
☐ Yes ☐ No

Neck circumference greater than 40 cm?
☐ Yes ☐ No

Gender, male?
☐ Yes ☐ No

High risk of obstructive sleep apnea = answering "yes" to 3 or more questions
Low risk of obstructive sleep apnea = answering "yes" to less than 3 questions

Adapted from:
STOP Questionnaire: *A Tool to Screen Patients for Obstructive Sleep Apnea*
Frances Chung, F.R.C.P.C., Balaji Yegneswaran, M.B.B.S., Pu Liao, M.D., Sharon A. Chung, Ph.D., Santhira Vairavanthan, M.B.B.S., Sazzadul Islam, M.Sc., Ali Khajehdehi, M.D., Colin M. Shapiro, F.R.C.P.C.
Anesthesiology 2008; 108:812-21 Copyright 2008, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

Obtained from

https://www.priorityhealth.com/provider/clinicalresources/~/media/documents/medical/stop-bang-sleep-apnea-questionnaire.pdf

Appendix D

Consent to Adapt Instruments and Research Design

Katie Pottle <katiepottle@gmail.com> Fri, Dec 9, 2016 at 3:10 PM
To: "Valerio, Teresa" <tvaleri@ilstu.edu>

Dr. Valerio,

I spoke with you earlier this year regarding your 2014 article, *The Effects of an Online Educational Program on Nurse Practitioners' Knowledge of Obstructive Sleep Apnea in Adults*. Again, thank you for sharing your pre-test/post-test and educational module with me. Regarding my thesis research study, I would like to utilize your Likert-based question regarding the likelihood of evaluating patients for OSA. Additionally, I would like to mention that my pre-test/post-test and educational module was adapted from your instruments. Although I created my own PowerPoint and pre-test/post-test, I reviewed your instruments to identify prominent themes, and further adapted the content to make it appropriate for dental hygiene students. Would I have your permission to include these two statements within my thesis?

Thank you very much!

--
Katie Pottle
(307) 679-6033

Katie Pottle <katiepottle@gmail.com> Sun, Dec 11, 2016 at 12:08 PM
To: "Valerio, Teresa" <tvaleri@ilstu.edu>

Dr. Valerio,

Specifically, I would like to say "consent to adapt the pre-test/post-test and utilize a similar research design was obtained from the authors of this study." Would this be okay?

Thank you!

[Quoted text hidden]

Valerio, Teresa <tvaleri@ilstu.edu> Mon, Dec 12, 2016 at 2:27 PM
To: Katie Pottle <katiepottle@gmail.com>

Hi Katie,

Glad to hear your thesis is progressing well.

Regarding my work published in 2014 by the title *The Effects of an Online Educational Program on Nurse Practitioners' Knowledge of Obstructive Sleep Apnea in Adults,* I am the sole author of this work and give the following permissions. For your thesis, you may use the Likert-based question regarding the likelihood of evaluation patients for OSA. Additionally, you have my consent to adapt the pre-test/post-test and utilize a similar research design.

Regards,

Teresa D. Valerio, DNP, APN, FNP-BC, CBSM

Appendix E

Pre-test/Post-test Assessment

Understanding and Identifying Obstructive Sleep Apnea
Pre-test and Post-test

Select one response for each of the following questions:

1. As determined by polysomnography, an Apnea-Hypopnea Index (AHI) of 15-29 respiratory events per hour indicates
    a. Mild OSA
    b. Moderate OSA
    c. Severe OSA
    d. No diagnosis of OSA

    Correct answer: B

2. The prevalence of OSA syndrome is
    a. Higher in men
    b. Higher in women
    c. Equally common in men and women

    Correct answer: A

3. Which of the following is NOT an adverse health condition associated with OSA:
    a. Hypertension
    b. Type II diabetes
    c. Alopecia
    d. Coronary heart disease

    Correct answer: C

4. Which of the following is NOT a risk factor for OSA:
    a. Menopause
    b. Female gender
    c. Obesity
    d. African American race

    Correct answer: B

5. Regarding Mallampati Classification, an individual is determined to be Class III when the soft palate is not visible. Mallampati Class III is considered high risk for OSA.
    a. The first statement is true and the second statement is false
    b. The first statement is false and the second statement is true
    c. Both statements are true

d. Both statements are false

Correct answer: B

6. Which of the following is considered to be the "gold standard" diagnostic test for OSA:
    a. Portable monitors
    b. Berlin Questionnaire
    c. Polysomnography
    d. STOP-BANG Questionnaire

    Correct answer: C

7. Current research suggests that OSA treatment with positive airway pressure devices is superior to treatment with mandibular advancement devices. Oral devices are recommended for individuals with severe OSA and poor adherence to positive airway pressure devices.
    a. The first statement is true and the second statement is false
    b. The first statement is false and the second statement is true
    c. Both statements are true
    d. Both statements are false

    Correct answer: A

8. Which of the following is the **most** accurate questionnaire for predicting OSA diagnosis?
    a. Berlin Questionnaire
    b. Epworth Sleepiness Scale
    c. STOP-BANG Questionnaire
    d. Wisconsin Sleep Questionnaire

    Correct answer: A

9. Which of the following is the **least** accurate questionnaire for predicting OSA diagnosis?
    a. Berlin Questionnaire
    b. Epworth Sleepiness Scale
    c. STOP-BANG Questionnaire
    d. Wisconsin Sleep Questionnaire

    Correct answer: B

Case Study #1

Tyrel is a 34-year-old white male who presents as a new dental patient. The patient takes medication for hypertension and type II diabetes. The patient is classified as obese, with a BMI of 31. To assess Mallampati Classification, the dental hygienist asks the seated patient to open his mouth and protrude his tongue. The dental hygienist is able to see the patient's soft palate and possibly the base of the uvula. From the periodontal assessment, it is determined Tyrel has generalized early periodontal disease. Further questions it is determined the patient snores loudly (almost every day) and his wife is often bothered by the noise. Additionally, his wife has also noticed the patient occasionally stops breathing during his sleep (1-2 times per week). The patient is a commercial truck driver and reports occasionally feels fatigued after sleep and during the day (1-2 times per week), but doesn't recall ever nodding off while driving. Based on this information, the dental hygienist scores the patient as "positive" in two categories of the Berlin Questionnaire.

10. Which of the following significantly increases the risk for OSA in this patient?
    a. Occupation
    b. Caucasian race
    c. Age
    d. Obesity

    Correct answer: D

11. Which of the patient's health conditions is commonly associated with OSA?
    a. Hypertension
    b. Type II diabetes
    c. Periodontal disease
    d. All of the above
    e. Both A & B

    Correct answer: D

12. Based on the description provided, the patient has a Mallampati Classification of IV, which is considered high risk for OSA.
    a. The first statement is true and the second statement is false
    b. The first statement is false and the second statement is true
    c. Both statements are true
    d. Both statements are false

    Correct answer: B

13. Based on the Berlin Questionnaire, the patient's risk for OSA is
    a. High
    b. Moderate
    c. Low

    Correct answer: A

Case Study #2

Rebecca, a 52-year-old white female, presents for periodontal maintenance. Upon reviewing her medical history, the patient reports she has recently seen a physician to assist in managing the symptoms of menopause. The patient currently takes medication for hypothyroidism, high blood pressure, and anxiety. The patient is of average weight, with a BMI of 23 and a neck circumference of 13 inches. To assess Mallampati Classification, the dental hygienist asks the seated patient to open her mouth and protrude her tongue. The dental hygienist is able to see the patient's soft palate and a portion of the uvula. Upon further questioning, the patient reports her husband has started to notice her snoring loudly, but has never observed altered breathing during her sleep. Overall, the patient reports she feels well-rested during the day. Based on this information, the dental hygienist assigns the patient a score of three on the STOP-BANG Questionnaire.

14. Which of the following significantly increases the risk for OSA in this patient?
    a. Age
    b. Female gender
    c. Menopause
    d. Both A & C
    e. All of the above

    Correct answer: D

15. Which of the patient's health conditions is commonly associated with OSA?
    a. Hypothyroidism
    b. High blood pressure
    c. Anxiety
    d. All of the above

    Correct answer: B

16. Based on the description provided, the patient has a Mallampati Classification of II, which is considered low risk for OSA.
    a. The first statement is true and the second statement is false
    b. The first statement is false and the second statement is true
    c. Both statements are true
    d. Both statements are false

    Correct answer: C

17. Based on the STOP-BANG Questionnaire, the patient's risk for OSA is
    a. High
    b. Moderate
    c. Low

    Correct answer: A

Post-test only

1. After completing the OSA educational module, do you believe screening for OSA is important? Why or why not? [free response answer]
2. What challenges do you anticipate in screening patients for OSA? [free response answer]
3. After participating in this educational program, how likely are you to evaluate your adult patients for obstructive sleep apnea?

Very Unlikely		Unsure		Very likely
1	2	3	4	5

Appendix F

Informed Consent Statement

DNHY 341S Students,

My name is Kathrine Pottle, and I am currently pursuing a Master of Science in Dental Hygiene degree at Eastern Washington University. For my thesis, I am conducting research on the effectiveness of an online module in educating dental hygiene students regarding screening for obstructive sleep apnea (OSA). As part of my research, I have developed the OSA educational module you will be completing.

Professor Jones has required that you complete the educational module as DNHY 341S course content. This will include completing a pre-test and demographic questionnaire, viewing an OSA educational video, and completing a post-test and program evaluation. Additionally, you will be asked to complete the same post-test two weeks following completion of the educational module, to test knowledge retention. SurveyMonkey© will be used to complete the assessments, and you will be asked to provide the identification number that Professor Jones has assigned you. Only Professor Jones will know which student corresponds to which identification number. She will only have access to the first post-test scores, which will be used for assigning student grades.

If you choose to participate in this research study, you will be consenting to the use of your anonymous data for research and publication purposes. This will include data from the pre-test, demographic questionnaire, post-test, program evaluation, and second post-test. As anonymous, this data will not be linked to you in any way. You are under no obligation to participate, and your consent or non-consent to the use of your data will be anonymous and will not impact your academic grade in any way. As an incentive for participation, pizza will be provided during class on March 2nd, 2017 if all eligible students consent to the research study and complete the entire research protocol.

If you have any questions or concerns about this survey please contact myself (contact information below), or my thesis advisor Sarah Jackson, RDH, MS at 509-828-1299, sarah.jackson@ewu.edu; or the department chair at EWU Ann O'Kelley Wetmore, RDH MSDH, 509.828.132, awetmore@ewu.edu. If you have any concerns about your rights as a participant in this research or any complaints you wish to make, you may contact Ruth Galm, Human Protections Administrator at Eastern Washington University 509-359-7971, rgalm@ewu.edu.

Thank you,

Kathrine Pottle, RDH, BSDH
Email: kpottle@eagles.ewu.edu
Cell phone: (307) 679-6033

Appendix G

Demographic Questionnaire

Obstructive Sleep Apnea Educational Intervention of Dental Hygiene Students

Demographic Questionnaire

Please answer the following demographic questions to the best of your ability.

Responses will remain anonymous.

1. What is your age?
    a. 18-22 years old
    b. 23-27 years old
    c. 28-32 years old
    d. 33-37 years old
    e. 38-42 years old
    f. 43+ years old
2. What is your gender?
    a. Female
    b. Male
3. What is your ethnicity?
    a. White/Caucasian
    b. Hispanic/Latino
    c. African American
    d. American Indian/Alaskan Native
    e. Asian
    f. Native Hawaiian/Pacific Islander
    g. Other
4. What is the highest degree you currently hold?
    a. High school diploma or equivalence
    b. Associate degree
    c. Bachelor degree
    d. Master degree
    e. Doctorate degree
    f. Other
5. Has a member of your immediate family (parent, spouse, sibling, child, or self) been diagnosed with obstructive sleep apnea?
    a. Yes
    b. No

Appendix H

Program Evaluation

Obstructive Sleep Apnea Educational Intervention of Dental Hygiene Students

Program Evaluation

Please evaluate the educational program by rating the following statements to the best of your ability.

Use the following rating system to evaluate the presentation and presenter.
1 – Strongly Disagree, 2 – Disagree, 3 – Unsure, 4 – Agree, 5 – Strongly Agree

Educational Module Evaluation				
The presenter was knowledgeable about obstructive sleep apnea (OSA).				
1	2	3	4	5
Program content was appropriate to my level of understanding.				
1	2	3	4	5
Program material was presented in a way that helped me to learn.				
1	2	3	4	5
Online learning was as effective as face-to-face instruction.				
1	2	3	4	5
The program provided me with the information I need to screen patients for OSA.				
1	2	3	4	5
The pre-test and post-test adequately assessed my knowledge of OSA.				
1	2	3	4	5
The online module was easy to navigate.				
1	2	3	4	5
I am satisfied with the knowledge gained from this presentation.				
1	2	3	4	5

Appendix I

Official Letter to DH Program Directors

Dear Ann O'Kelley Wetmore,

As you are aware, I am currently pursuing a Master of Science in Dental Hygiene degree at Eastern Washington University. For my thesis, I am conducting research on the effectiveness of an online module in educating dental hygiene students regarding screening for obstructive sleep apnea (OSA). I am hoping to conduct this research during the spring 2017 semester.

If the EWU Dental Hygiene Program agrees to participate, the educational module I have developed will be used as course content for DNHY 341S *Management of Medically Compromised Patients*. Students will be required to complete a pre-test and demographic questionnaire, view an OSA educational video, and complete a post-test and program evaluation. Additionally, students will complete the post-test a second time to test knowledge retention. A Canvas module will be created for research purposes, and will include SurveyMonkey links for assessments and a YouTube link for the OSA educational video.

Although students will be required to complete the educational module, the use of their anonymous assessment data is voluntary. Upon opening the pre-test, students will be asked if they consent to the use of their data for research and publication purposes. As an incentive for participation, pizza will be provided during DNHY 341S if all eligible students consent to participation and complete the entire research protocol. Prior to implementation, Professor Jones will introduce the research to the students, and will provide each student will an identification number. As the researcher, I will not know which students corresponds to which identification number. Once the educational module is complete, I will export and forward results from the first post-test to Professor Jones for grading purposes.

Although I know we have previously discussed your dental hygiene program's participation in this research, I am looking for an official statement of agreement to participation in the research study. If your program chooses to participate, the official statement can be in the form of a letter or email communication. If there are any questions I can answer, please do not hesitate to contact me.

Thank you,

Kathrine Pottle, RDH, BSDH
Email: kpottle@eagles.ewu.edu
Cell phone: (307) 679-6033

Appendix J

Valerio & Heaton (2014) Pre-test/Post-test

The Effects of an Online Educational Program on Nurse Practitioner's Knowledge of Obstructive Sleep Apnea in Adults
Pre and Post Test Questions

Please select one response for each of the following statements or questions.

1. Obstructive sleep apnea (OSA) should be considered in the evaluation of adult patients because:
   a) Nearly 30% of patients with OSA are undiagnosed and untreated.
   b) About 26% of the population is at-risk for OSA.
   c) OSA is associated with an estimated 10% increased risk for motor vehicle crash.
   d) Middle-age adults have a higher prevalence of OSA than older-adults.

   Answer: b

Case 1.
Jerry is a 45-year-old white male who presents to establish care because of a health insurance change. When asked about his daytime function he states he is "tired all day" for over 5 years. Often awakens feeling "tired", despite sleeping about 8 hours a night, and naps on days off. His wife complains about his snoring, has threatened to sleep in another room, and reports that she hears pauses in his breathing. He is a semi-truck driver, and has felt that he could doze in the afternoon while driving. His vehicle has hit the rumble strip several times in the past while he has been driving. He is concerned that he has little interest in sex, and has gained about 20 lbs in the last 5 years. Jerry has a past medical history significant for hypertension treated with hydrocholorthiazide, hyperlipidema treated with simvastatin, and one episode of atrial fibrillation, which is not currently being treated. His family history is positive for myocardial infarction, obstructive sleep apnea and hypertension. On physical exam, the BMI is noted to be 33 kg/m^3; B/P is 140/88. Neck circumference is 18 inches. Exam of the upper airway indicates a Mallampati classification score of 4 and an erythematous uvula.

2. Which of the following significantly increases the risk for OSA in this patient?
   a) negative family history
   b) age
   c) Caucasian race
   d) obesity

   Answer: d

3. Identify the common health consequence caused by OSA in this patient.
   a) hyperlipidemia
   b) deep vein thrombosis
   c) hypertension
   d) erectile dysfunction

   Answer: c

4. The most important reason to screen this patient for OSA is because of:
    a) health insurance change
    b) motor vehicle crash risk
    c) wife's complaint of snoring
    d) body image concerns

   Answer: b

5. Select the most common daytime symptom that would increase your suspicion of OSA in this patient?
    a) excessive sleepiness
    b) decreased libido
    c) morning headache
    d) decreased memory

   Answer: a

6. Which of the following night-time symptoms seen in this patient are most commonly associated with OSA?
    a) nocturnal diaphoresis and limb numbness
    b) snoring and witnessed apnea
    c) nocturnal gastroesophageal reflux and chest pain
    d) restless sleep and vocalizations

   Answer: b

Case 2

Sandy is a 53-year-old white female who present for a pre-operative medical clearance. When asked about her sleep, she reports she is "fatigued" on awakening and awakens several times a night for about 3 years. She does not doze when inactive, although feels "tired" many days, and has to "push through the day". She is a nurse practitioner and works during the day. She awakens frequently for diaphoresis and to urinate 3 times a night. Her husband reports she snores softly and that this has become more frequent in the last 3 years. She sleeps 8-9 hours most nights. Her weight has been stable for over 10 years. Her past medical history is significant for perennial allergic rhinitis and conjunctivitis treated with antihistamines, adenotonsillectomy, menopause at age 50, hypothyroidism treated with levothyroxine, and left shoulder rotator cuff repair planned. On physical exam, the BMI is noted to be 24 kg/m^3; B/P is 118/78. Neck circumference is 13 inches. Examination of the upper airway indicates a Mallampati classification score of 3 with retrognathia, a highly arched hard palate, and nasal turbinate hypertrophy.

7. Which of the following increases the risk for OSA in this patient?
    a) female
    b) allergic rhinitis
    c) menopause
    d) torn left rotator cuff

   Answer: c

8. Which night-time symptom found in this patient is commonly associated with OSA?
    a) nocturia
    b) heavy snoring
    c) sleeps 8-9 hours most nights
    d) nasal congestion

Answer: a

9. What physical feature in this patient is most consistent with the diagnosis of OSA?
    a) retrognathia
    b) BMI 24 kg/m^3
    c) nasal turbinate hypertrophy
    d) neck circumference of 13 inches

Answer: a

10. The most important reason to screen this patient for OSA is:
    a) occupation
    b) surgical procedure planned
    c) age
    d) female gender

Answer: b

11. Which symptoms found in this patient are more commonly seen in women, compared to men, with OSA?
    a) fatigue and frequent awakenings
    b) unrefreshing sleep and learning problems
    c) excessive sleepiness and decreased hunger
    d) nocturnal diaphoresis and decreased memory

Answer: a

Case 3.

C.J. is a 28-year-old African-American male who presents for a follow-up appointment for hypertension. He reports that he takes his medication regularly, exercises 2 days a week, tries to stay on the diet plan "but I am too tired to always do it". When asked about his sleep, he states that his wife notices he snores and is restless during sleep. He awakens at night due to "upset stomach" for which he takes Tums. He admits that he often awakens feeling unrefreshed and with a headache. He works day shift as an accountant, and has felt that his memory and concentration at work have become a problem. His wife and children complain that he just wants to sit on the couch when he gets home. He sleeps 7 hours a night on weekdays and 9 hours on weekends. Past medical history is significant for hypertension treated with lisinopril and verapamil, type 2 diabetes treated with Metformin, gastroesophageal reflux disorder treated with Tums, and stress headaches treated with Tylenol as needed. On physical exam, the BMI is 28 kg/m^3; B/P is 138/92. A1C is 7.2%. Examination of the upper airway indicates a Mallampati classification score of 4 with macroglossia, tonsil size of 2+, and neck circumference is 17 inches.

12. In this patient, what daytime symptom increases your suspicion for OSA?
    a) excessive calorie intake
    b) low physical activity
    c) reduced concentration
    d) increased sleep on weekends

    Answer: c

13. This patient's airway exam was noted as a Mallampati classification score of 4, identify this score in the picture below.

    a)

    b)

    c)

    d)

Source: http://www.lifespan.org/applications/inquiz/custom/cme/modsedation/
Answer: b

14. An appropriate OSA screening tool for this patient is:
    a) Berlin questionnaire
    b) STOP-BANG
    c) Overnight oximetry
    d) Epworth Sleepiness scale

    Answer: a

15. Which of the following conditions seen in this patient are most commonly associated with OSA?
    a) gastroesophageal reflux disorder and atrial fibrillation
    b) stress headaches and obesity
    c) hypertension and type 2 diabetes
    d) hyperlipidemia and congestive heart failure

    Answer: c

Post-test only

1. After participating in this educational program, how likely are you to evaluate your adult patients for obstructive sleep apnea? Circle one.

Not likely		Unsure		Very likely
1	2	3	4	5

Appendix K

Valerio & Heaton (2014) Educational Module Topical Outline

Table 2 Topical outline for "Obstructive Sleep Apnea Evaluation Essentials" educational program

Slides 2–4	Obstructive Sleep Apnea (OSA) prevalence	Define OSA Clinical population Underdiagnosis	8 min
Slides 5–9	High-risk conditions	Cardiovascular conditions Endocrine conditions Neurovascular conditions Motor vehicle crashes Preoperative	7 min
Slides 10–17	Health consequences	Morbidity Mortality Safety Quality of life	10 min
Slides 18–21	OSA symptoms	Nighttime symptoms Daytime symptoms Functional issues	7 min
Slides 22–27	OSA signs	Body habitus Blood pressure Facial features Airway features	10 min
Slides 28–36	Evaluation process and tools	Screening plan Differential diagnosis Routine health evaluation High-risk conditions Screening tools	11 min Total: 53 min

Note. Slide 1: title and introduction; slides 33 and 34: Berlin Questionnaire; slide 35: STOP-Bang tool; slides 37, 38, and 39: references.

Valerio & Heaton (2014), Table 2, p. 607.

Appendix L

Cover Letter and Consent Form – Pilot Study

Dear EWU MSDH Students,

As you all know, my name is Kathrine Pottle and I am currently pursuing a Master of Science in Dental Hygiene degree at Eastern Washington University. For my thesis, I am conducting research on the effectiveness of an online module in educating dental hygiene students regarding screening for obstructive sleep apnea (OSA). During the spring 2017 semester, I will be implementing an online module with students in the DNHY 341S *Management of Medically Compromised Patients* course. A Canvas© module will be created for the purpose of this research. The module will include SurveyMonkey© links for a pre-test, demographic questionnaire, post-test, and program evaluation, as well as a YouTube link for an OSA educational video. Students will also be provided with a SurveyMonkey© link to complete the post-test a second time, two weeks following completion of the module, to test knowledge retention.

As a MSDH student with experience in research methodologies and the dental hygiene process of care, I am asking for volunteers to participate in the pilot study. Participation in the pilot study will include completing the pre-test, post-test, demographic questionnaire, program evaluation, viewing the educational module video, and providing feedback on all components of the educational module. You are under no obligation to participate in the research, however the feedback you provide has the potential to positively impact this research study. Your participation or non-participation will be anonymous. SurveyMonkey© will be used to complete assessments and to provide feedback on the educational module. All data and feedback will remain anonymous. Total estimated time to complete the pilot study is approximately 2 hours. If you choose to participate, please complete the pilot study by [insert date].

If you have any questions or concerns about this survey please contact myself (contact information below), or my thesis advisor Sarah Jackson, RDH, MS at 509-828-1299, sarah.jackson@ewu.edu; or the department chair at EWU Ann O'Kelley Wetmore, RDH MSDH, 509.828.132, awetmore@ewu.edu. If you have any concerns about your rights as a participant in this research or any complaints you wish to make, you may contact Ruth Galm, Human Protections Administrator at Eastern Washington University 509-359-7971, rgalm@ewu.edu.

If you choose to participate, please follow the instructions contained in this email. Providing feedback on the educational module implies consent to the pilot study.

Thank you,

Kathrine Pottle, RDH, BSDH
Email: kpottle@eagles.ewu.edu
Cell phone: (307) 679-6033

Appendix M

Research Introduction Script

Obstructive Sleep Apnea Educational Intervention of Dental Hygiene Students

Research Introduction Instructions

Who: Merri Jones, EWU instructor

What: Introduction of research study to potential participants

When: Thursday, January 26th, 2017

Where: *Management of Medically Compromised Patients* course

Why: To increase awareness of study

Introduction Script:

"I wanted to take a moment to discuss a research study you are being asked to participate in. Kathrine Pottle is a MSDH student at EWU. She is conducting her thesis research study on the effectiveness of an online module in educating dental hygiene students on obstructive sleep apnea. She has developed an online OSA educational module, which will be required as course content for this class. After class today, you will find that an *Obstructive Sleep Apnea* module has opened in Canvas©. The Canvas© module will provide you with instructions on how to complete the educational module. You will have until Sunday, January 29th to complete the pre-test and demographic questionnaire. The link for the OSA educational video will become active on Monday, January 30th and will remain active until Sunday, February 5th. You will have from Monday, February 6th to Thursday, February 9th to complete the post-test and program evaluation. The post-test **will** be graded, and **will** influence your DNHY 341S grade. Two weeks following completion of the post-test, you will be asked to take the post-test a

second time, to test knowledge retention. Only the first post-test will influence your academic grade. Again, these instructions will be provided in the Canvas© module.

Although completion of the educational module is required, your consent to use the anonymous data from the pre-test, demographic questionnaire, post-test, program evaluation, and second post-test is voluntary. Upon opening the pre-test, you will be asked if you consent for your anonymous data to be used for research and publication purposes. Today, I will give each of you a random identification number. You will be asked to provide this identification number for each assessment. Kathrine will not know which identification number corresponds to which student, but I will use these numbers to assign grades for the first post-test. You are under no obligation to consent to the use of your data, and your consent or non-consent will remain strictly anonymous. As an incentive for participation, if all eligible students consent to the research study and complete the entire research protocol, pizza will be provided during class on March 2nd."

Appendix N

Implementation Schedule

Research Introduction

- During DNHY 341S class on January 26th, 2017 (Thurs)
- Completed by Merri Jones (course instructor) using *Research Introduction Script*
- Random identification numbers given to students

Pre-test and Demographic Questionnaire

- SurveyMonkey© links active following DNHY 341S class on January 26th (Thurs) until January 29th (Sun) at midnight

OSA Educational Video

- YouTube link active from 12:01 a.m. on January 30th (Mon) until February 5th (Sun) at midnight

Post-test and Program Evaluation

- SurveyMonkey© links active from 12:01 a.m. February 6th (Mon) until February 9th (Thurs) at midnight

Second Post-test

- Reminder during DNHY 341S class on February 23rd (Thurs)
- SurveyMonkey© link active following DNHY 341S class on February 23rd (Thurs) until February 26th (Sun) at midnight

Reward Incentive

- Pizza delivered to class DNHY 341S class on March 2nd

Notes:

1. PI will activate and deactivate SurveyMonkey and YouTube links at schedule times.
2. PI will order pizza for DNHY 341S class if all eligible students consent to the research study and all participants complete the entire research protocol (pre-test, demographic questionnaire, post-test, program evaluation, and second post-test).

Appendix O

Canvas© Module Content

Module Overview

In this module, we will cover the topic of obstructive sleep apnea (OSA)

Learning objectives addressed in this module include:

1. Recall the prevalence of OSA in the United States.
2. Identify the health consequences of untreated OSA.
3. Identify the risk factors of OSA.
4. Compare the methods of definitive OSA diagnosis.
5. Compare available treatment options for OSA.
6. Compare and contrast OSA screening methods.
7. Apply OSA screening method to a case study.

To-Do List

- Complete the pre-test
- Complete the demographic questionnaire
- View the OSA educational video
- Complete the post-test
- Complete the program evaluation
- Complete the second post-test

Task #1

- Complete the pre-test and demographic questionnaire using the following SurveyMonkey links. As the pre-test contains an informed consent statement, complete the pre-test first.

  Pre-test: https://www.surveymonkey.com/r/QQ2PPQM

  Demographic questionnaire: https://www.surveymonkey.com/r/QQQVSXL
- Complete the pre-test and demographic questionnaire by Sunday, January 29th at midnight.

Task #2

- Print the attached forms for the Berlin Questionnaire, Epworth Sleepiness Scale, and STOP-BANG Questionnaire. You will need these as you watch the OSA educational video.
- View the attached OSA educational video by Sunday, February 5th at midnight
- Note: the video will only be available from Monday, January 30th to Sunday, February 5th at midnight

Task #3

- Complete the post-test and program evaluation using the following SurveyMonkey links by Sunday, February 9th at midnight
- Note: the SurveyMonkey links for the post-test and program evaluation will only be available from Monday, February 6th to Sunday, February 9th at midnight.
  Post-test: https://www.surveymonkey.com/r/QQRSQQC
  Program evaluation: https://www.surveymonkey.com/r/QQMQL78

Task #4

- Complete the post-test a second time using the following SurveyMonkey link:
  Second post-test: https://www.surveymonkey.com/r/QJPYTJT
- Note: the second post-test will be available following DNHY 341S class on Thursday, February 23rd and will close on Sunday, February 26th at midnight.

Appendix P

Pilot Study Instructions

1. Complete the pre-test using the following SurveyMonkey link.

   https://www.surveymonkey.com/r/QQ2PPQM

2. Complete the demographic questionnaire using the following SurveyMonkey link.

   https://www.surveymonkey.com/r/QQQVSXL

3. View the OSA educational video using the following YouTube link.

   [to be developed]

4. Complete the post-test using the following SurveyMonkey link.

   https://www.surveymonkey.com/r/QQRSQQC

5. Complete the program evaluation using the following SurveyMonkey link.

   https://www.surveymonkey.com/r/QQMQL78

6. Provide feedback using the following SurveyMonkey link.

   https://www.surveymonkey.com/r/MQ8BDSS

Curriculum Vitae

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EDUCATION

Graduate Education

In Progress	Master of Science in Dental Hygiene Eastern Washington University – Spokane, WA

Undergraduate Education

2013	Bachelor of Science in Dental Hygiene University of Wyoming – Laramie, WY
2013	Associate of Applied Science in Dental Hygiene (High Honors) Sheridan College – Sheridan, WY
2013	Associate of Science in General Studies (High Honors) Sheridan College – Sheridan, WY

CLINICAL DENTAL EXPERIENCE

July 2016 – Current	Full-Time Clinical Dental Hygienist Park View Dental – Helena, MT
August 2015 – July 2016	Part-Time Clinical Dental Hygienist Pinecreek Dental – Salmon, ID
May 2014 – July 2015	Full-Time Clinical Dental Hygienist Pinedale Dental – Pinedale, WY
September 2013 – May 2014	Full-Time Clinical Dental Hygienist Cody Family & Cosmetic Dentistry – Cody, WY

PROFESSIONAL LICENSURE AND CERTIFICATIONS

2016 – Present	State of Montana Dental Hygienist, DEN-RDH-LIC-11544
2015 – Present	State of Idaho Dental Hygienist, DH-3230
2014	Standard Proficiency for Soft Tissue Lasers Academy of Laser Dentistry
2013 – Present	State of Utah Dental Hygienist with Local Anesthesia, #8687962-9920
2013 – Present	State of Wyoming Dental Hygienist – Certified in Expanded Function of Local Anesthesia, Nitrous Oxide Analgesia and Lasers, License #1128

TEACHING EXPERIENCE

Spring 2017	Co-Course Director DNHY 489 *Intro to Dental Public Health* Eastern Washington Online Degree Completion Program
Spring 2017	Development of Syllabus Template Eastern Washington University Dental Hygiene Program
Spring 2017	Accreditation Review of Dental Hygiene Course Syllabi Eastern Washington University Dental Hygiene Program
Feb 2017	Clinical Teaching Observation & Temporary Fill-In Faculty Eastern Washington University Dental Hygiene Clinic
Feb 2017	*National Board Dental Hygiene Examination Introduction* Lecture Eastern Washington University - Senior Dental Hygiene Students
Feb 2017	*Pharmacology - Gastrointestinal Drugs* Lecture Eastern Washington University – DNHY 320S
Oct 2017	*Intra-Oral Assessment* Lecture & Clinical Competency Evaluation Sheridan College Dental Hygiene Program

PROFESSIONAL AFFILIATIONS

2015-Present	American Dental Education Association Active Student Member
2013-Present	American Dental Hygienist's Association Active Student Member
2013-Present	Sigma Phi Alpha – Dental Hygiene Honor Society Active Member
2011-2013	Student American Dental Hygienist's Association Sheridan College Chapter President (2012-2013) ADHA Annual Session – District 12 Alt. Student Delegate (2012)

AWARDS

2013	Sigma Phi Alpha Award – Sheridan College Dental hygiene honor society membership
2013	Edna Stowe-Thomas Award – Sheridan College Student exemplifying leadership, responsibility, honesty, integrity, college involvement, and morale building

COMMUNITY SERVICE

2013	Kindergarten Day Sheridan College Dental Hygiene Clinic – Sheridan, WY Introduced kindergarten students to the dental setting
2013	Give a Kid a Smile Day Sheridan College Dental Hygiene Clinic – Sheridan, WY Prophylactic treatment, radiographs, and sealant placement
2013	Miles for Smiles 5k Run Sheridan, WY Proceeds purchased electric toothbrushes for special needs patients